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NOVEMBER 6, 1902.

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AMERICAN MACHINIST

ISSUED WEEKLY BY THE HILL PUBLISHING CO., WORLD BLDG., NEW YORK.

25TH ANNIVERSARY NUMBER.

VOL. 25. No. 45.

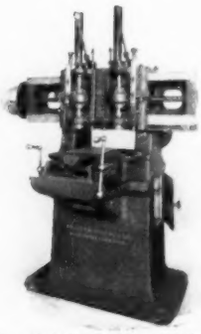
"After all, young man, there is nothing like a Nicholson File, the choice of all critical mechanics. Sold everywhere."

NICHOLSON FILE CO.,
PROVIDENCE, R.I., U.S.A.

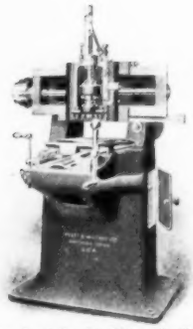
Collection of New Designs by

PRATT & WHITNEY CO.

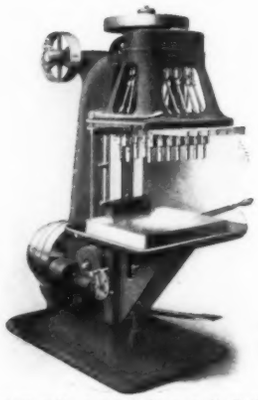
16-Spindle Adjustable Multi-Spindle Drill.



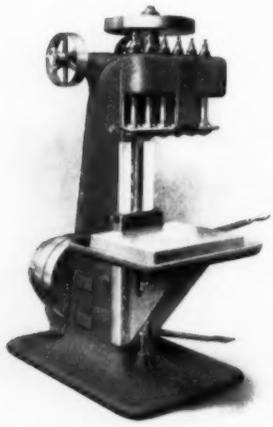
Two-Spindle Profiling Machine.



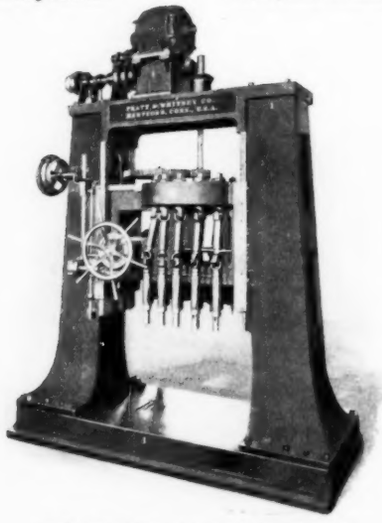
One Spindle Profiling Machine.



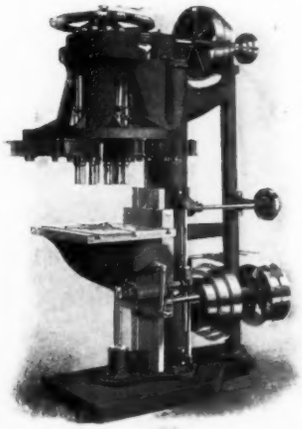
16-Spindle Adjustable Multi-Spindle Drill.



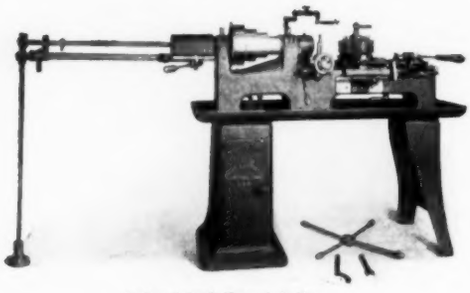
6-Spindle Gang Drill.



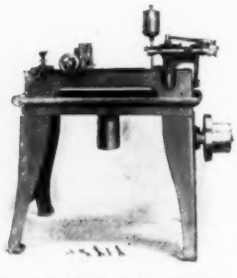
10-Spindle Adjustable Multi-Spindle Drill.



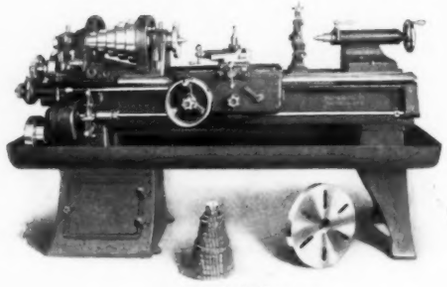
10-Spindle Adjustable Multi-Spindle Drill.



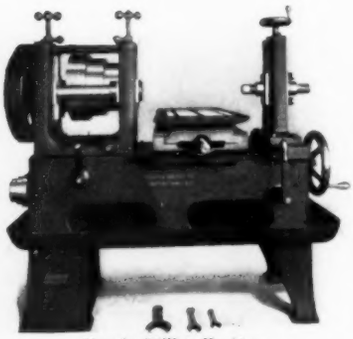
5-8 x 4-inch Turret Lathe.



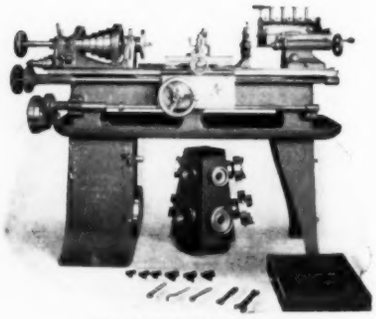
Two-Spindle Centering Machine.



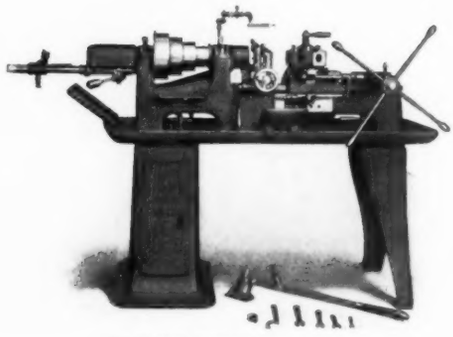
14-inch Lathe.



Lincoln Milling Machine.



10-inch Toolmaker's Lathe.



1 x 10-inch Turret Lathe.

New York: 136 Liberty Street.
Boston: 144 Pearl Street.
Philadelphia: 21st & Callowhill Sts.

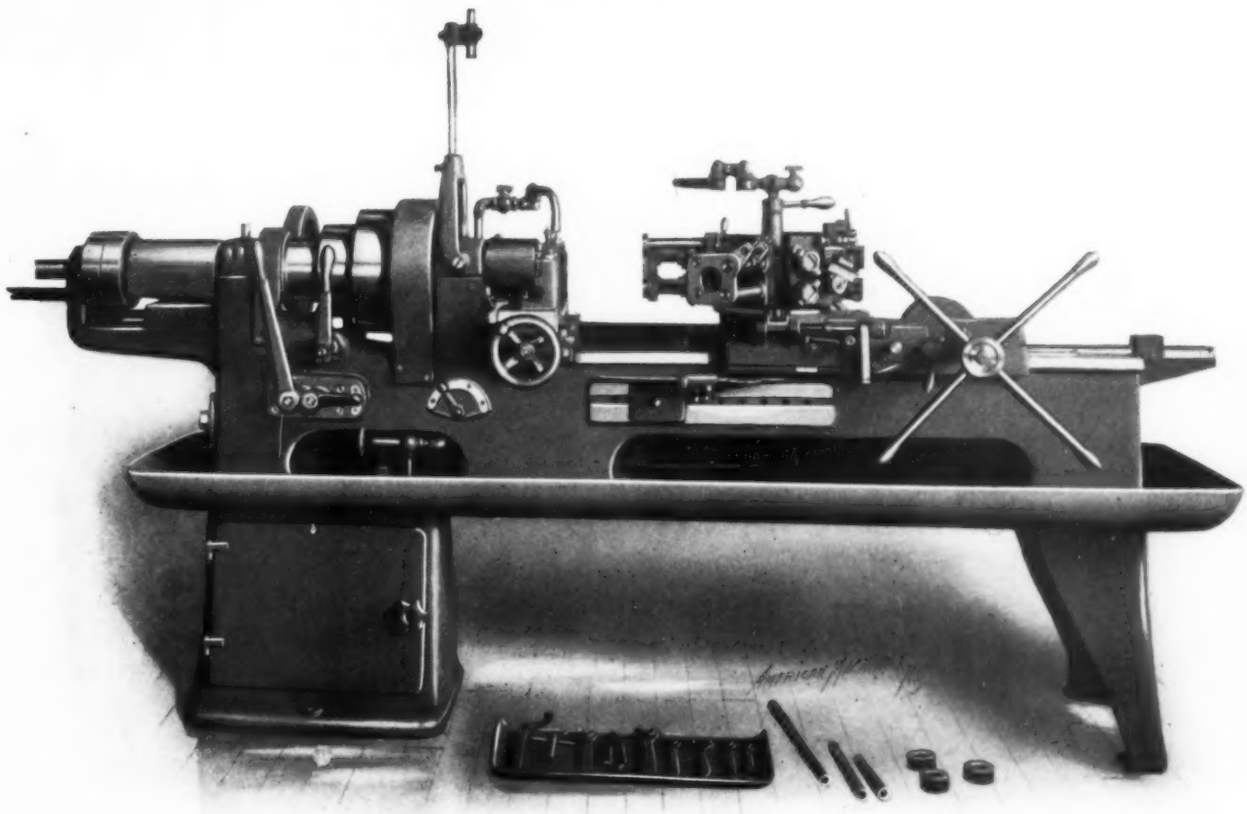
PRATT & WHITNEY CO.
WORKS:
HARTFORD, CONN., U. S. A.

Pittsburg, Pa.: Frick Building.
Chicago: 46 South Canal Street.
St. Louis: 516 North Third Street.
London: 23-25 Victoria St., S. W

NEW MODEL
TURRET LATHES

FIVE SIZES:

5-8 x 4 1-2 inch, 1 x 10 inch, 1 1-2 x 18 inch, 2 x 26 inch and 3 1-8 x 36 inch.



2 x 26 inch Pratt & Whitney New Model Turret Lathe, showing multiple roughing tool and multiple finishing tool.

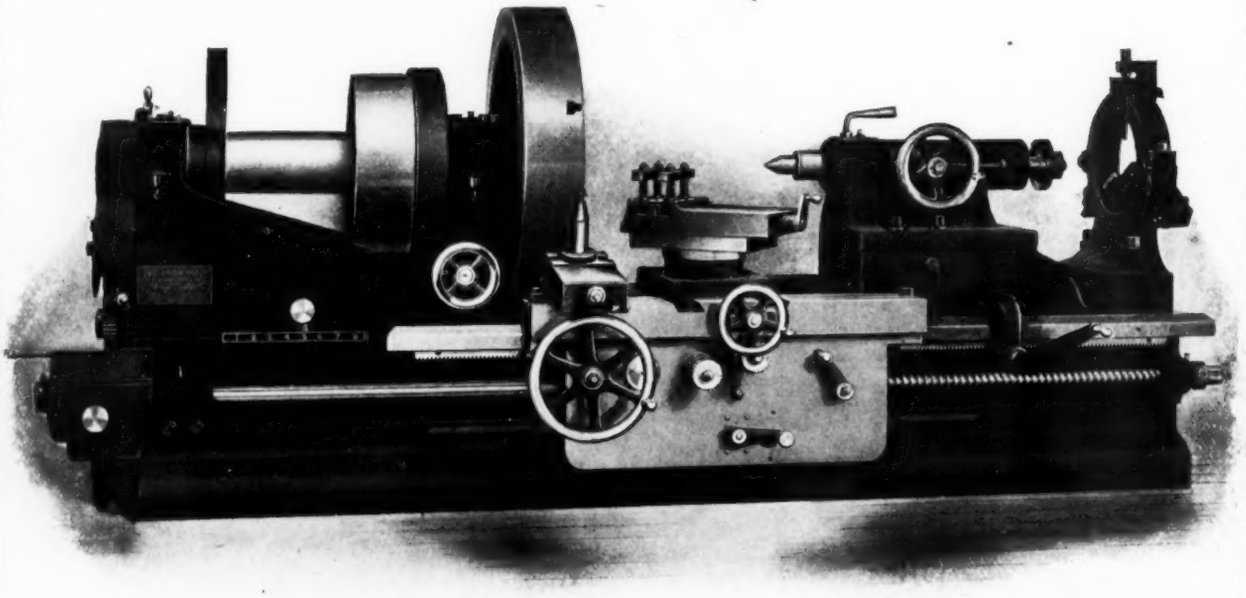
Send for new booklet A, describing the 5/8 x 4 1/2 inch and 1 x 10 inch Turret Lathes to 136 Liberty Street, New York.

Pratt & Whitney Co.
Hartford, Conn.

OFFICES:

New York: 136-138 Liberty St. Boston: 144 Pearl St. Philadelphia, 21st and Callowhill Sts. Pittsburg, Pa.: Frick Building. Chicago: 46 So. Canal St. St. Louis: 516 N. Third St. Dayton, 133 Salem St.

48-IN. LATHE.



To the Up-To-Date Manufacturer.

The magnificent efficiency of steels now being offered for cutting tools calls for lathes of increased power, rigidity and wearing qualities.

The manufacturer who is fully alive to the signs of the times can no longer afford to buy lathes on price; his very necessities call for tools that will do the work, do it well, do it quickly and yet live a long life.

That is the lathe we offer.

SIZES: 14-Inch Swing to 48-Inch Swing.

The
Lodge & Shipley Machine Tool Co.

Cincinnati, Ohio, U.S.A.

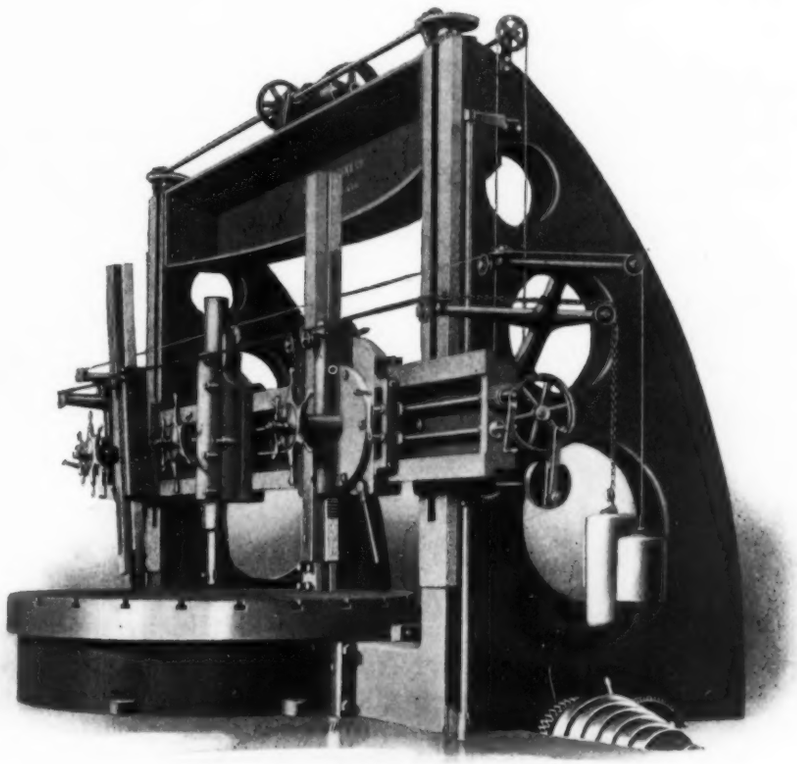
Cable—Betwildel, Wilmington.

Betts Machine Co.,

WILMINGTON, DEL., U.S.A.

MAKERS OF

Heavy Machine Tools
of the MOST ADVANCED TYPES.



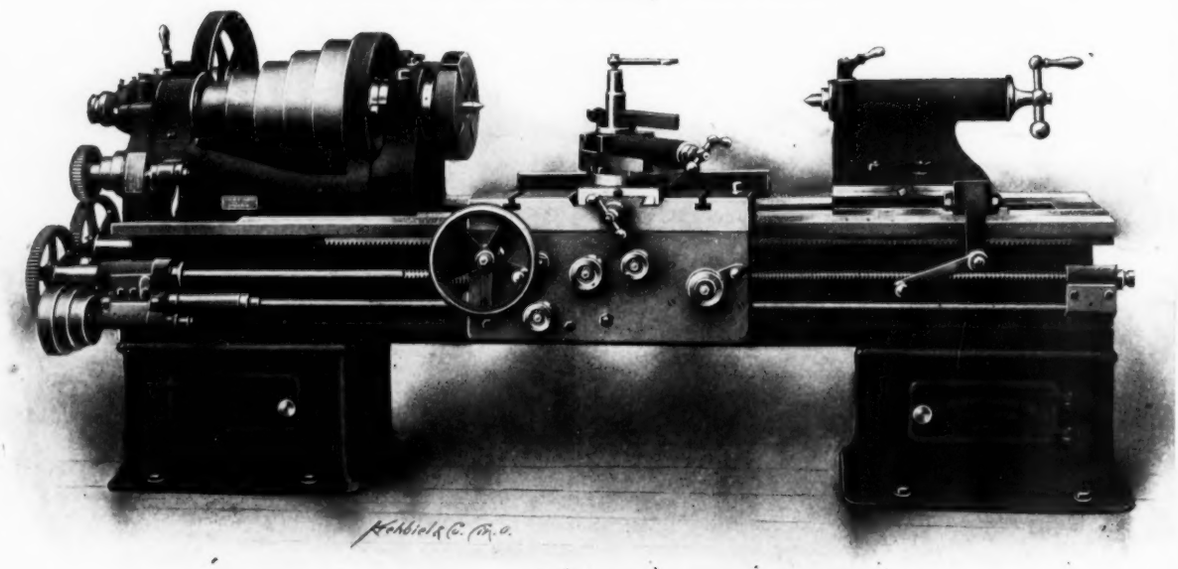
The above illustration shows the Standard 12-foot Boring and Turning Mill, with Special Boring Head, as made for the Atlas Engine Works, Indianapolis, Ind.

WE MAKE...

Vertical Boring and Turning Mills, from 5 ft. to to 20 ft. swing; Horizontal Boring and Drilling Machines, usual sizes; Slotting Machines, from 8 in. to 24 in. stroke; Planing Machines, from 36 in. square to 10 ft. square.

BRADFORD
Engine Lathes

14 TO 36-INCH SWING.



25-in. x 10-ft. Bradford Lathe.

In this Lathe provision has been made for either a positive geared or belt feed, with Automatic Stop. The Lead Screw is used for screw cutting only, and is as near perfection as it is possible to attain, all lead screws in Bradford Lathes being chased from a Master Screw.

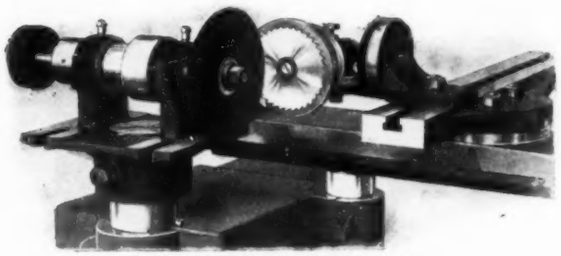
A Heavy Carriage and a substantial Headstock render the Lathe capable of extra duty if subjected to heavy work. A High Carbon Crucible Steel Spindle, ground and mounted in Adjustable Bronze Bearings, contribute to the strength and accuracy found in this machine.

Write Us for Special Circulars.

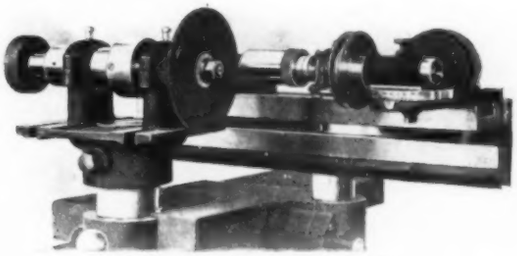
Bradford Machine Tool Co.

CINCINNATI, O., U.S.A.

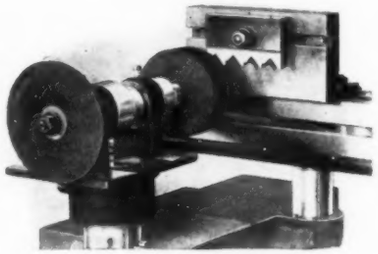
PACIFIC TOOL & SUPPLY CO., San Francisco, Cal., Agents for Pacific Coast.
Foreign Agents.—Chas. Churchill & Co., Ltd., London, Birmingham, Manchester, Glasgow, Newcastle-on-Tyne. Schuchardt & Schutte, Berlin, Cologne, Vienna, St. Petersburg, Brussels, Stockholm.



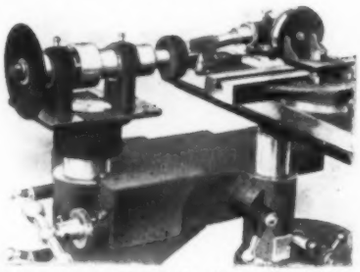
Grinding Sides of a Slitting Saw.



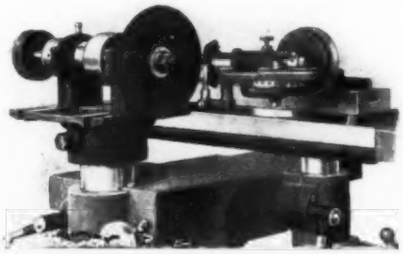
Grinding a Drill Jig Bushing.



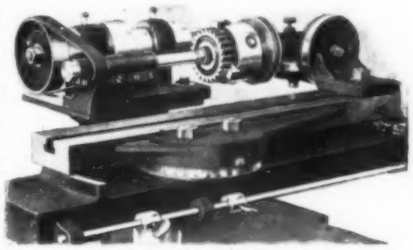
Sharpening a Flat Formed Tool.



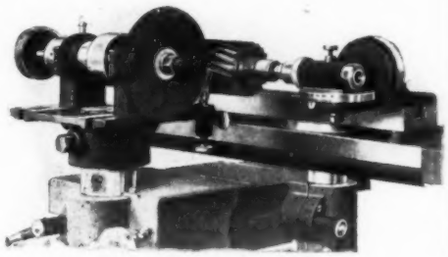
Sharpening End Teeth of an End Mill.



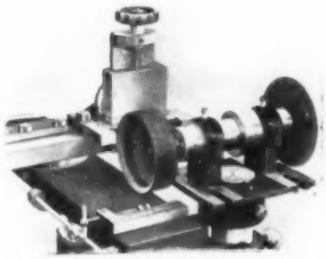
Sharpening a Right-Hand Angular Cutter.



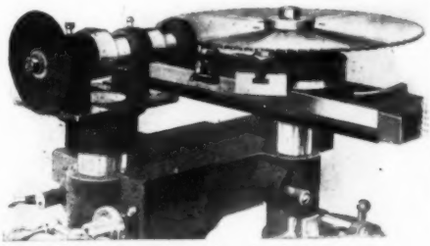
Internal Grinding.



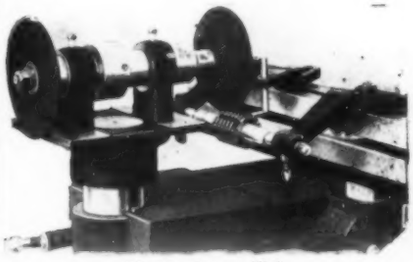
Sharpening a Spiral Mill.



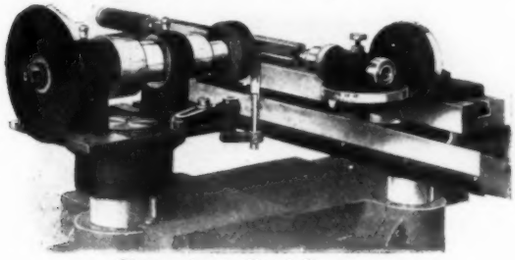
Grinding a Snap Gage to Size.



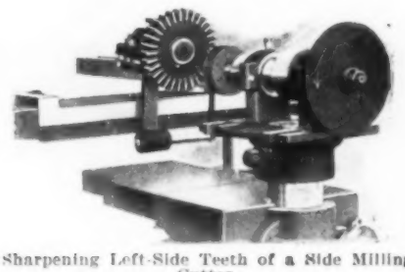
Sharpening a 24 in. Cold Saw.



Sharpening a Hob.



Sharpening a Hand Reamer.



Sharpening Left-Side Teeth of a Side Milling Cutter.

THE Cincinnati Universal Cutter and Tool Grinder will sharpen correctly any style or shape of milling cutter, tap, hob or formed lathe tool and will do a great variety of general tool grinding besides.

These illustrations show a few examples—our

TREATISE ON CUTTER GRINDING

shows many more and tells about them all. It contains information that will be of value to you. Ask for it.

The Cincinnati Milling Machine Co.

CINCINNATI, O., U.S.A.

EUROPEAN AGENTS—Schuchardt & Schutte, Berlin, Cologne, Vienna, St. Petersburg, Brussels, Stockholm and New York. Adolphe Janssens, Paris. Chas. Churchill & Co., London, Birmingham, Manchester, Newcastle-on-Tyne and Glasgow. The Niles Tool Works Co., 23 Victoria St., London, S. W.

Four Inch Spindle Horizontal Boring Machine

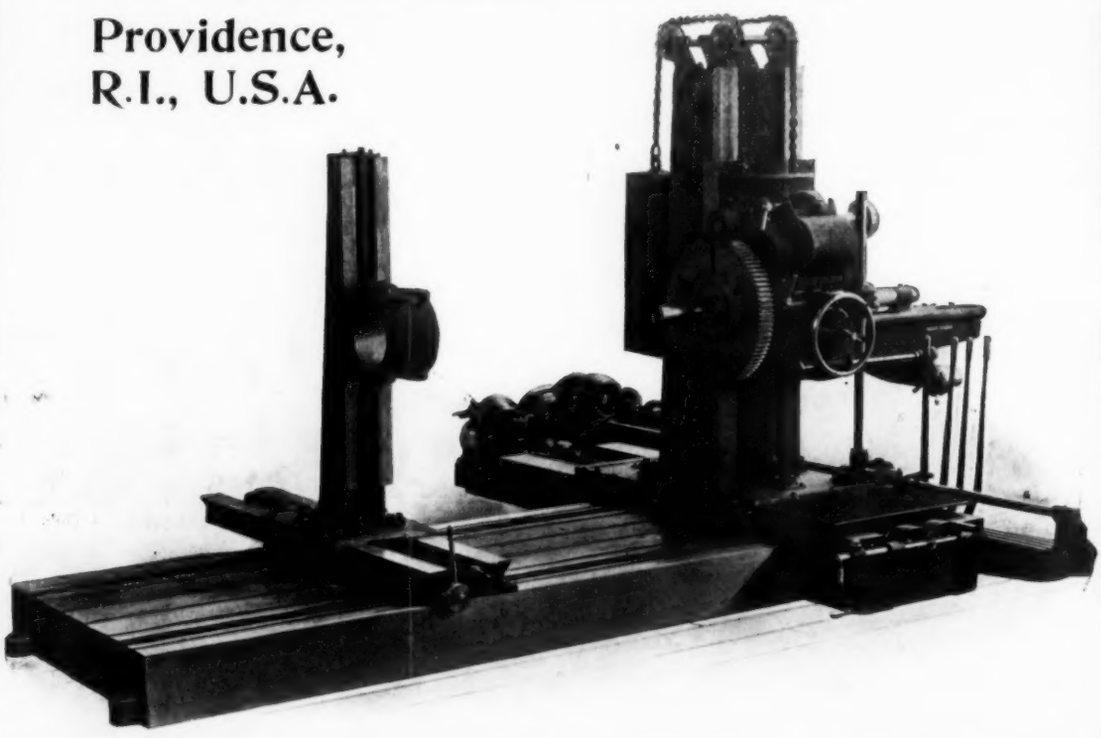
This is one of several similar tools of different sizes for boring, tapping and milling. It is one of unusual worth in the production of such work, and is especially adapted to the handling of odd shaped work. It is suitable for light or heavy work, and with equal facility drilling, boring, tapping and milling operations may be conveniently done at one fastening of the work, thereby insuring extreme accuracy combined with a time-saving of no mean worth.

This machine consists of a horizontal spindle with automatic feed in a head attachment to column, so as to afford a vertical movement. The column is supported on a bed and provided with horizontal movement. The platen or working table is made in various sizes as may be required, and on it work can be conveniently and accurately fastened in such a way as to afford the completion of many operations without removal.

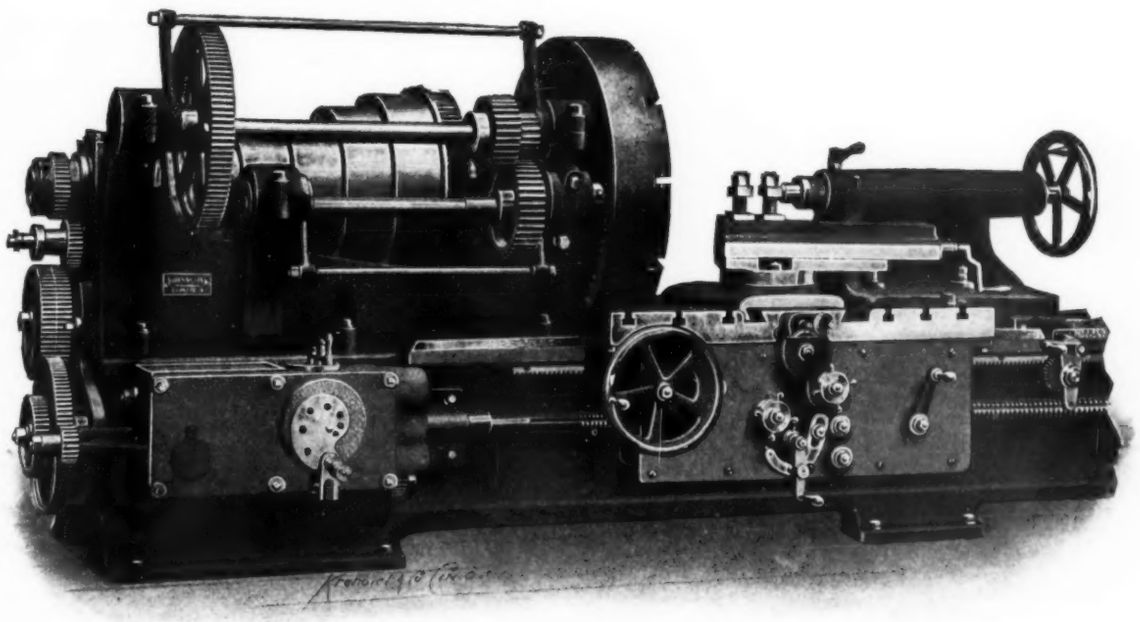
The tool is one that should have a place in your shop. We will be pleased to send full details, and we invite inquiries.

The Beaman & Smith Co.,

Providence,
R.I., U.S.A.



All Quality All The Way.



S. & B. make lathes for heavy work, for the handling of such heavy work in a way best calculated to bring the fastest net gain. Some few of the features going to make these heavy lathes—36-in. and 42-in. swing—the good lathes they are, are: A double apron, preventing any strain from overhang; a new instantaneous change device for feeds and screw cutting; all control of machine from the front without waste of time; a powerful angular feed of 12 in. to compound rest; half nuts are of bronze, insuring great strength and rigidity, and 40 and 1 other things of equal value in the fast and accurate handling of heavy work.

Schumacher & Boye,

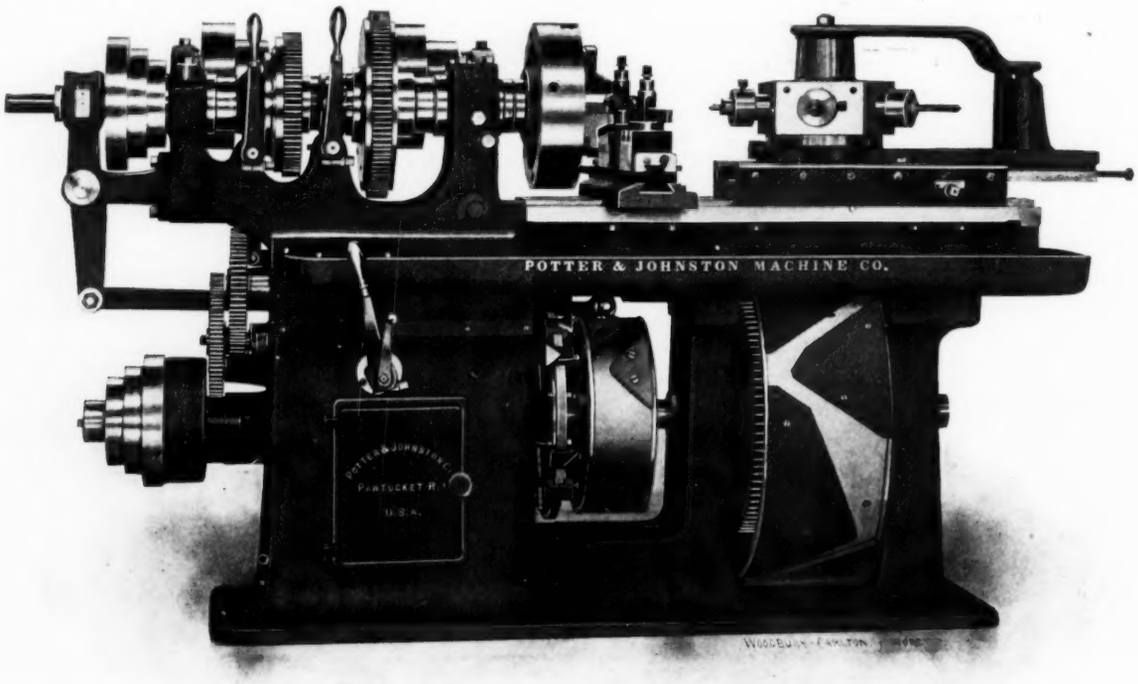
Cincinnati, Ohio, U.S.A.

The attention of all Manufacturers who produce Duplicate Parts in quantities from Castings of Iron, Steel or Bronze, is called to our

NEW MODEL

Manufacturing Automatic Chucking and Turning Machine.

This machine is the latest development in the automatic line for handling castings; and combines strength, rigidity, power and accuracy, and is by far the most efficient machine on the market for handling this class of work. The machine is made in three types, viz.: machine with geared automatic change speed head; machine with belt driven change speed head; machine with plain head.



MANUFACTURING AUTOMATIC CHUCKING AND TURNING MACHINE,
With Geared Automatic Change Speed Head, Cross Slide, Heavy 15-Inch Scroll Chuck and Automatic Back Facing Attachment.

These tools are specially well adapted for the **rapid** and **accurate** production of the component parts of

Machine Tools; Stationary, Marine and Locomotive Engines; Sewing Machines; Motor Carriages; Cream Separators; Pumping Machinery; Textile, Agricultural and Electrical Machinery.

Machine swings 17 inches over the bed and 10 inches over the cross slide, and will handle pieces up to 6 inches long. Standard set of cams furnished with the machine will operate machine on all ordinary pieces up to 6 inches in length, and require no adjustment. Cross slide can be operated automatically at any time in conjunction with the turret.

We have already equipped a number of up-to-date shops with these tools, where they are producing highly satisfactory results, reducing the labor cost of production, and in many cases bringing repeat orders.

Send us blue prints or samples of any work which you think would be suitable for the machine, and we will write and let you know just what the machine is capable of doing on your work.

Also Double Turret Manufacturing Lathes and Universal Shaping Machines.

Write for Complete Circular.

Potter & Johnston Machine Company,

Pawtucket, R. I., U.S.A.

NEW YORK OFFICE: 126 Liberty Street. WALTER H. FOSTER, Manager.

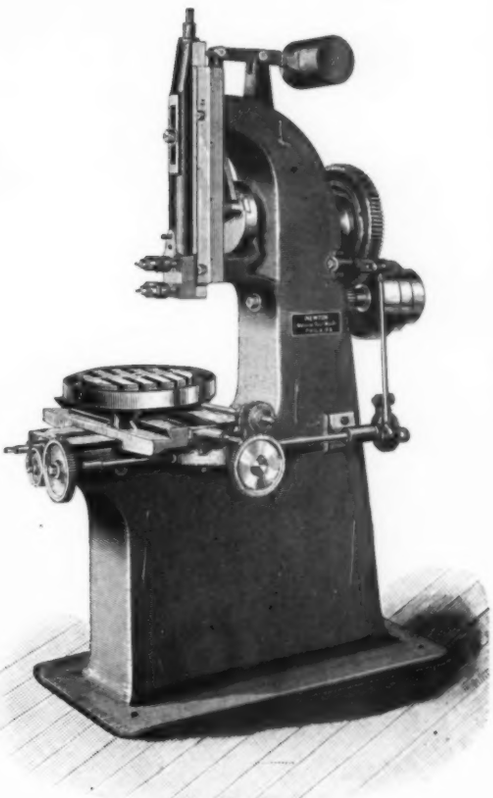
NEWTON

Slotting Machines,

6-in., 8-in. and 10-in. Stroke,

with fixed Ram Slide; 12-in., 14-in., 16-in., 18-in. and 20-in. Stroke, with Adjustable Ram Slides.

All machines have the steel relief tool apron.



6-in. Slotting Machine.

20-in. Slotting Machine.

Milling Machines.
Cold Saw Cutting-Off Machines.
Boring Machines.
Multiple Drilling Machines.
Rotary Planers.
Special Tools designed and built.
Portable Electric Driven Machine Tools.

NEWTON MACHINE TOOL WORKS,

(INCORPORATED.)

PHILADELPHIA, U. S. A.

MENTAL GYMNASTICS DONE AWAY WITH
ON THE
NEW BICKFORD RADIAL

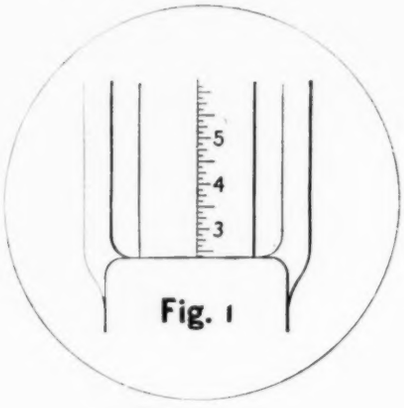
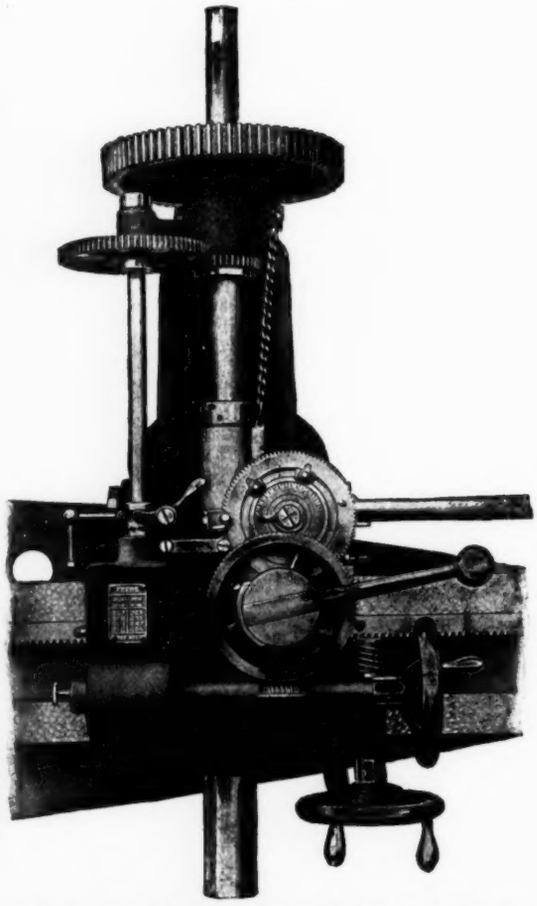


Fig. 1



The depth gauge on the New Bickford Radial enables the operator to read all depths from zero, thereby avoiding the liability of error incident to reading a given distance from a fraction.

Compared with the ease of reading depths from a zero dial, the usual method of working from graduations on the spindle sleeve is awkward in the extreme, as the following simple example will demonstrate. Suppose that a workman wishes to drill to a depth of 2 11-16 inches, and that after the drill has entered the work to the edge of its cone, the graduations on the spindle sleeve occupy the position shown in Fig. 1. To what point on the scale must the spindle be advanced in order to drill to the required depth? "The first long line"—reasons the workman—"is one-eighth plus a sixty-fourth above the top of the bearing; taking the long line as zero, 2 11-16 would come 1-16 less than the 5¼ graduation, so I must drill down to a point one-eighth plus a sixty-fourth below a sixteenth less than 5¼, or to a point five sixty-fourths below the 5⅛ line." As the above mental gymnastics, incident to reading from a fixed scale, must be repeated on all but through holes, it is not at all strange that workmen have heretofore preferred to gauge depths in their own way, either by means of a scale or a pair of calipers.

Our booklet **"56 Points of Vantage"** besides describing the Machine in detail, is full of interesting drilling truths. Send for it.

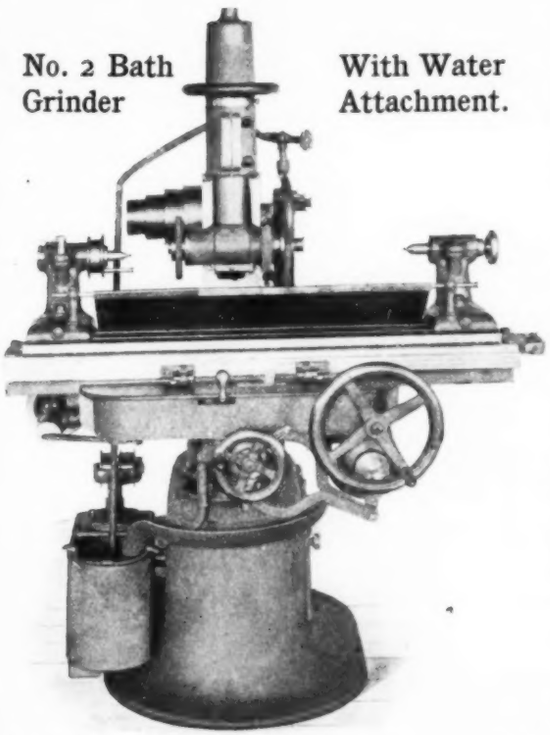
THE BICKFORD DRILL & TOOL COMPANY
CINCINNATI, OHIO, U. S. A.

31 A.

FOREIGN AGENTS—Schuchardt & Schutte, Berlin, Cologne, Vienna, St. Petersburg, Brussels, Stockholm and New York. Adolphe Janssens, Paris. Chas. Churchill & Co., Ltd., London, Birmingham, Manchester, Newcastle-on-Tyne and Glasgow. F. W. Horne, Yokohama, Japan.

THE BATH GRINDER

WILL GRIND ANYTHING



No. 2 Bath Grinder With Water Attachment.

It is a completely universal grinder different from all others. Its use insures accuracy in cutters, arbors and tools of every description ground upon it. This latest and improved form has been provided with a water attachment and is shown here arranged for circular grinding. The head is gibbed to a vertical slide, and is very rigid in any position. The grinder also has a large capacity in surface grinding.

Automatic Table Feed,	-	-	18 in.
Takes Between Centers,	-	-	25 "
Power Cross Feed,	-	-	7 "

HILL, CLARKE & COMPANY

MACHINERY MERCHANTS

14 S. CANAL ST. CHICAGO. 123 LIBERTY ST. NEW YORK

MAIN OFFICE 156 OLIVER ST. BOSTON.

PITTSBURG REPRESENTATIVE

CHAS. G. SMITH CO. 347 FIFTH AVE

A Complete Line of. . .

Upright Drills

8-In. to 50-In. Swing.

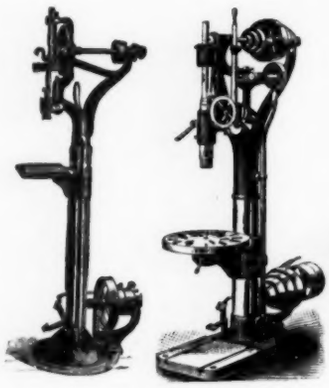
MANUFACTURED BY

W. F. & JohnBarnes Co.,

1995 Ruby Street,
Rockford, Ill., U.S.A.

. . . *Established 1872* . . .

Our machines are sold in every country of the world.

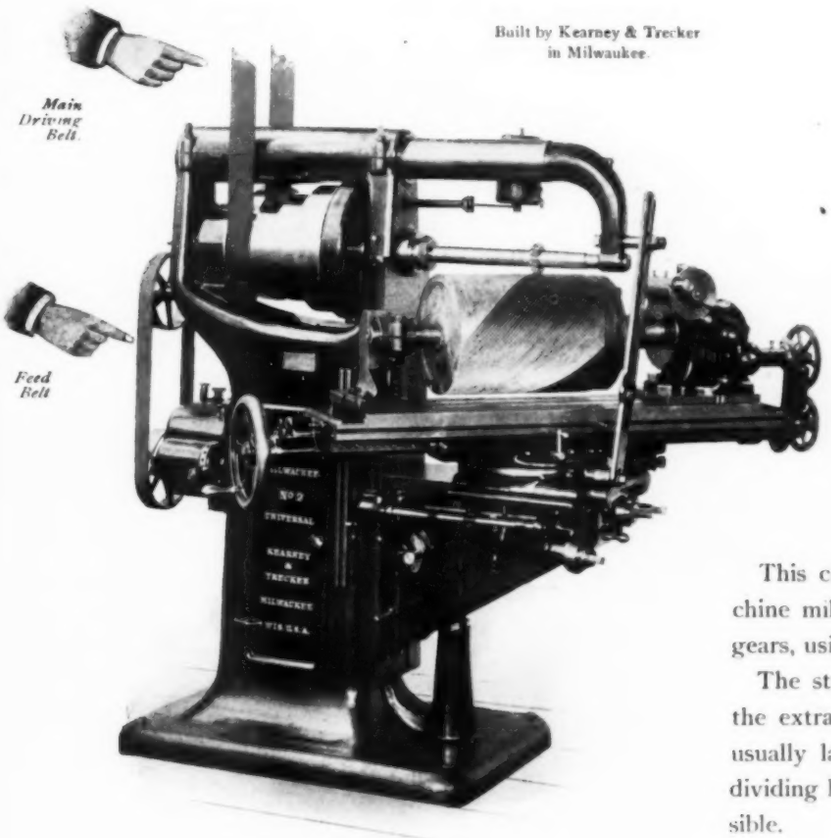


Foreign Agents—
Fenwick Freres & Co., 21 Rue Martel, Paris.
Chas. Churchill & Co., London, E. C.
C. S. Christiansen, Christiania, Norway.
H. P. Gregory & Co., Sidney and Melbourne.
Smellie & Co., Brisbane, Queensland.
Fred W. Horne, Yokohama.
Wm. Hill & Co., Shanghai.

Our Back Gear is the
NEATEST, CLEANEST, STRONGEST, MOST DURABLE, and LEAST NOISY.

A Chain is just as strong as its weakest link. No stronger.

Just so, our Milwaukee Milling Machine is just as powerful as the pulling capacity of its main driving belt. That's the test point. All other parts are proportioned to stand any strain the main belt will put upon them. The feed belt, for instance, will carry any cut the main belt will pull, just as any other and all other parts will. So it is only reasonable that the Milwaukee Milling Machine will do heavier work for its size than any other.



Built by Kearney & Trecker in Milwaukee.

This cut shows the No. 2 Machine milling a set of steel spiral gears, using three cutters at a time.

The strong box section knee, the extra long table and the unusually large worm wheel in the dividing head make this job possible.

Hill, Clarke & Company,

Machinery Merchants,

14 South Canal Street, Chicago.

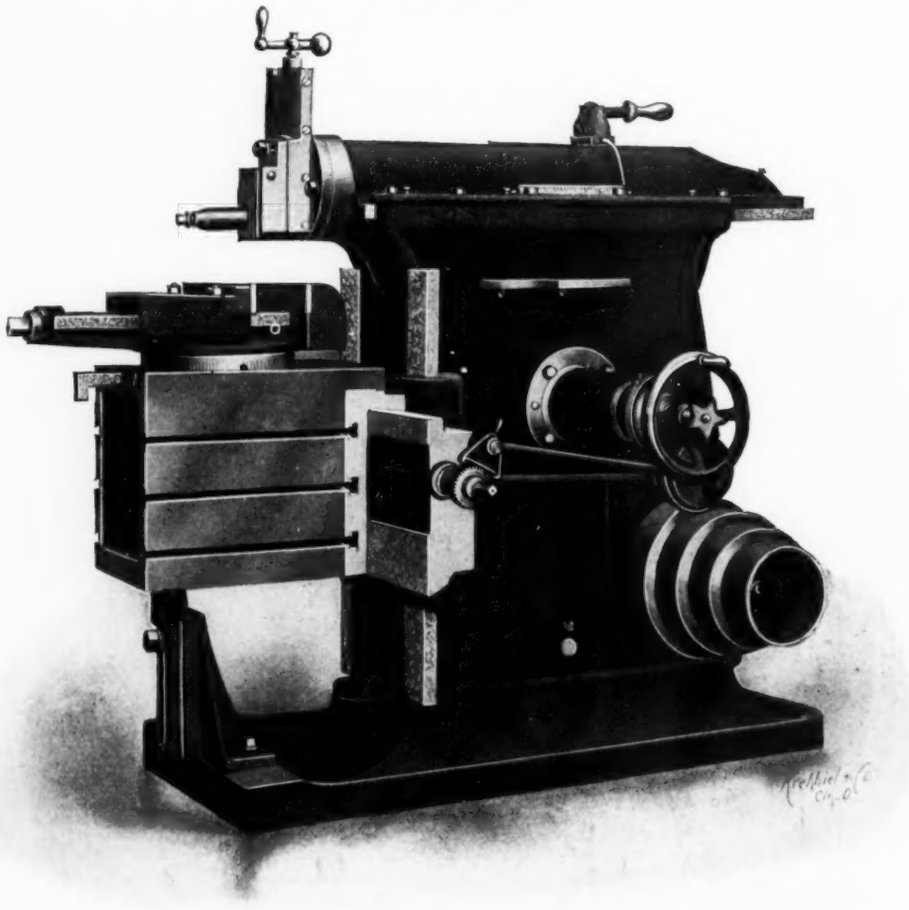
Main Office: 156 Oliver Street, Boston.

123 Liberty Street, New York.

Pittsburg Representative, Chas. G. Smith Co., 347 Fifth Avenue.

A Shaper Shaped To The Needs Of The Modern Shop,

is our New "American." It is designed for good work and quick work, so proves a profit puller wherever used. It can be arranged for electric drive in the way that makes the drive part of the tool.



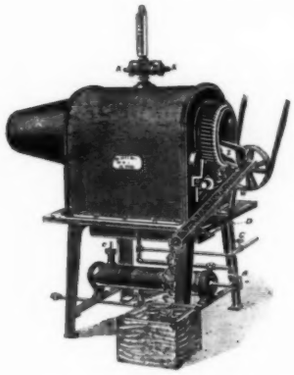
16-inch, 18-inch, 21-inch, 25-inch Back-Geared.

olumn is unusually strong; stroke of ram positive; back-gear :io unequalled. Head can be swiveled to 50° and has tool post iarge enough for holders with inserted cutters. It takes a book to show up all the fine points, and we have one we will send you.

The American Tool Works Company

Cincinnati, Ohio, U.S.A.

New York: The Fairbanks Co., Elm and Broome Streets. Boston Store: 36 Federal Street. Philadelphia: The Fairbanks Co. St. Louis Store: 720 N. Second St Pittsburg Store: Empire Building, L. V Blue, Manager Minneapolis: The Northern Machinery Co. Chicago Store: O. L. Packard Machinery Co., 34-16 S. Canal St. Milwaukee: O. L. Packard Machinery Co. Detroit: C. C. Wormer Machinery Co. San Francisco: Henshaw, Bulkley & Co. Birmingham: Milner & Kettig Co. Toledo: National Supply Co. Cleveland: The Strong, Carlisle & Hammond Co.



It's Easier to Control the Heat

in our gas furnaces than it is in the old, or even the newest style coal or coke furnace.

The proper temperature is more quickly gotten and more easily kept. There are never any burned jobs, and the labors of attendance amount to almost nothing.

These gas furnaces are economical, because there is no need of burning coal in the warming up process and when the work is done a turn of the valve stops all expense. You never stopped using a coal furnace that wasn't full of unburnt coal that burned slowly out, wasting its heat as it burned.

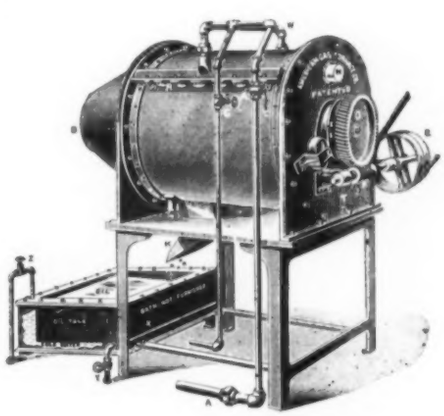
We make a good many different kinds of these furnaces for as many different kinds of service. Some of them are heating machines that pour out a steady stream of properly heated small things; some of them were designed for some particular factory that needed something out of the usual line. Perhaps you need something special, but we think that our new big catalog contains pictures and particulars of pretty nearly everything anybody could want in this line. Send for your copy of it.

AMERICAN GAS FURNACE CO.,

23 JOHN STREET, NEW YORK.

Chas. Churchill & Co., London, Birmingham, Manchester and Glasgow. Schuchardt & Schutte, Berlin, Cologne, Vienna, St. Petersburg. H. Glaenzer & Perreaud, Paris.

And fuel gas plants —we make them, too.



ALL CONTRACTS AND AGREEMENTS ARE CONTINGENT UPON STRIKES, ACCIDENTS AND OTHER OCCURRENCES BEYOND OUR CONTROL.
ALL QUOTATIONS ARE MADE FOR PROMPT ACCEPTANCE AND INCLUDE ONLY SUCH FIXTURES AS ARE SPECIFIED.

WORKS AT ERIE, PA.

Erie City Iron Works.

FOUR-VALVE AUTOMATIC CUT-OFF ENGINES.
HIGH SPEED and MEDIUM SPEED SINGLE VALVE AUTOMATIC CUT-OFF ENGINES.
THROTTLING GOVERNOR ENGINES.
STATIONARY, PORTABLE and VERTICAL STEAM BOILERS.
WATER TUBE BOILERS. FEED WATER HEATERS.

Erie, Pa. April 18th, 1902.

Fosdick & Holloway Machine Tool Co.,
Cincinnati, Ohio.

Gentlemen:-

We are very much pleased to state to you that the two Radial Drills which we have of your make are giving us the very best satisfaction in every particular.

We compliment you on these tools, and think they are the best tools of the kind that we have ever come in contact with.

Yours respectfully,
ERIE CITY IRON WORKS.
Thos Sullivan Gen Mgr.

(TED--B)

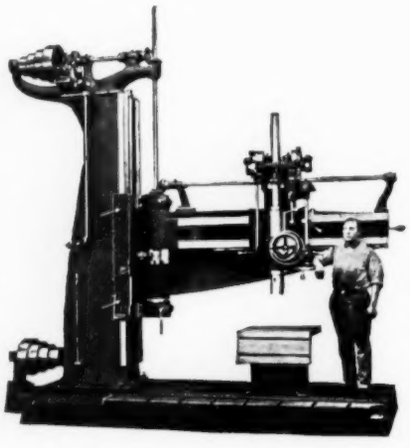
READ these Letters

We have hundreds of them testifying to the merits of our

RADIAL DRILLS

from the leading manufacturers of this country. We manufacture them in the following sizes:

Plain—2½, 3, 4, 5, 6, 7 and 8 ft. arms
Half and Full Universal—5 and 6 ft. arms.



INCORPORATED
MILWAUKEE HARVESTER CO.
MANUFACTURERS OF GRAIN & GRASS CUTTING MACHINERY.
CABLE ADDRESS HARVESTER MILWAUKEE
CODES USED A.I. & A.B.C. DIRECTORY, WESTERN UNION AND PRIVATE CODE
ADDRESS ALL COMMUNICATIONS TO THE COMPANY
OFFICERS: STEPHEN BULL, President; H. H. SCHULTE, V.Pres. & Sec'y-Treas.; H. F. CRANDALL, V.Pres. & Treas.; H. R. S. OWINGS, Secretary.

H. F. CRANDALL SUPT

Milwaukee Wis April 14, 1902.

The Fosdick & Holloway Machine Tool Co.,
Cincinnati, Ohio

Gentlemen.

We are pleased to state that the radial drill purchased from you some time ago has proved to be a first class machine. The position of spindle is easily changed, and it is held stiff and rigid under all conditions, consequently the machine is convenient to operate and does accurate work.

Yours truly,
Milwaukee Harvester Co.
H. F. Crandall
SUPT.

NEW YORK, 26 BROADWAY
CHICAGO, MARQUETTE BLDG
LONDON, 76 CANNON ST

AMERICAN BLOWER CO.

FANS, ENGINES, HEATERS, BLOWERS, DRY KILNS, SIRCO DRYERS, SPECIAL DRYERS, MECHANICAL DRAFT APPARATUS

WORKS AND MAIN OFFICE, DETROIT

Cable Address VENTILATOR DETROIT
A.B.C. AND LIEBER CODES

JAMES INGLIS, TREAS. AND MANAGER

DETROIT MICH | April 12th, 1902.

The Fosdick & Holloway Machine Tool Co.,
Cincinnati, Ohio.

Gentlemen:-

It gives us great pleasure to speak favorably of your 5' Universal Radial Drill which we have recently installed in our shop. We consider the machine well made in every point, and should you have occasion to refer any prospective customer to us, we will gladly add our testimony to your ability as machine tool builders. We are,

Yours truly,
American Blower Company.

Send for our new Catalog giving detailed information.

The Fosdick Machine Tool Co.,

CINCINNATI, OHIO, U. S. A.

Here's A Half A Dozen Good Things

...FROM...

The Many That Are Made by Crosby

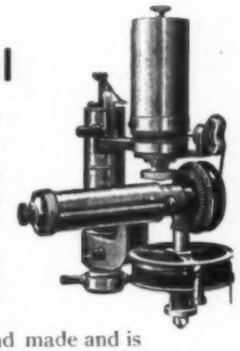
The Crosby Indicator

This is an Indicator that is above all, reliable. It gives you a correct card always, and without fuss or bother you can get two or more cards at the same time if you wish. In these days of high coal prices 'twill be well for you to find out whether you are getting full power returns from your engine, and if not to apply a remedy. The Crosby Indicator points the place for the application of the remedy.

TRADE-MARK

CROSBY

The Crosby Reducing Wheel



Special attention has been paid to the matters of strength, accuracy and durability. Bearings are comparatively frictionless. This apparatus is for those places where exacting conditions obtain.

It is attached to cylinder cock of engine and to the Indicator it is to serve. This is the best thing of its kind made and is worthy of your critical examination.

Pressure Gage

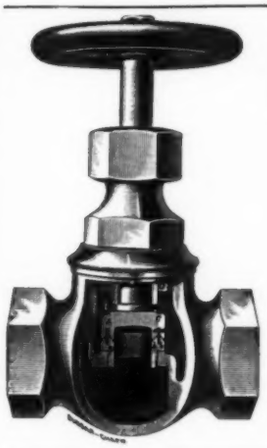
In the Crosby Improved Pressure Gage here shown, the tube springs are connected at each end to their respective parts by screw threads without the use of any soldering material whatever, thus insuring tight joints under all conditions of heat and pressure. In addition to the improved Bourdon tube springs so employed, careful attention has been given to the lever mechanism which transmits the free movements of these Bourdon tube springs to the index. These are a few of the many reasons why the Crosby Pressure Gage leads. Others on request.

Gage Tester

This is for testing pressure gages. It is simpler and cheaper than a mercury column and is equally accurate for all practical purposes. It can be carried from place to place, which is an advantage over the mercury column.

Comes in a neat case, has weights for testing up to 300 lbs. pressure of lead; other weights of iron for testing up to 1500 lbs. Keep your gages right and you'll be safe all the time.

Details on request.

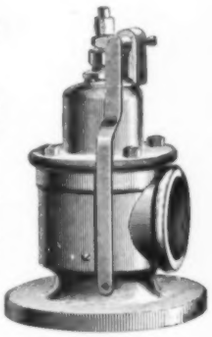


Spring Seat Valve

The Crosby Spring-Seat Globe and Angle Valves

Stand in a class by themselves. They are forever right and they last a long time. They are different, and in this difference lies their value to the user. The difference is explained in catalog, which we are pleased to send.

Crosby-Meady Pop Safety Valve



This is a Safety Valve in every sense of the word. It will not stick, it will always respond to the set pressure. It is to be depended upon at all times and under all conditions. You don't have to watch them.

This Valve is worth its weight in gold and might save you thousands of dollars.

DESCRIBED IN CATALOG.

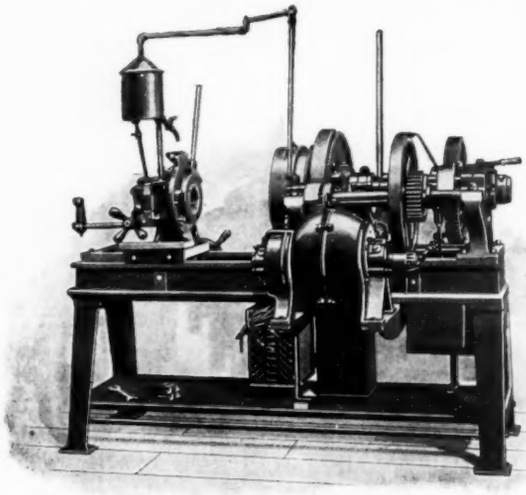
Crosby Steam Gage & Valve Company

Office and Works: BOSTON, MASS., U.S.A.

93-97 Oliver St., Boston, Mass. 21-23 W. Lake St., Chicago. 78 John St., New York. 147 Queen Victoria St., London.

Non-Sparking **Strong Torque**

DIRECT-CURRENT
MOTORS
FOR DRIVING MACHINE TOOLS



THE SPRAGUE ELECTRIC COMPANY

for many years has been closely identified with the principal achievements in the design and construction of direct-current electric motors, and is recognized as an authority upon the installation of power plants, machine shops, etc. The Sprague Company, through its long experience, has accumulated a vast amount of valuable data and is thus able to give correct specifications for the proper adaptation, power, speeds, etc. Write for Bulletins No. 20613 and No. 20713.

SPRAGUE
ELECTRIC COMPANY

General Offices: 527-531 West 34th Street, New York.

Branch Offices:

Chicago. Boston. St. Louis. Baltimore.

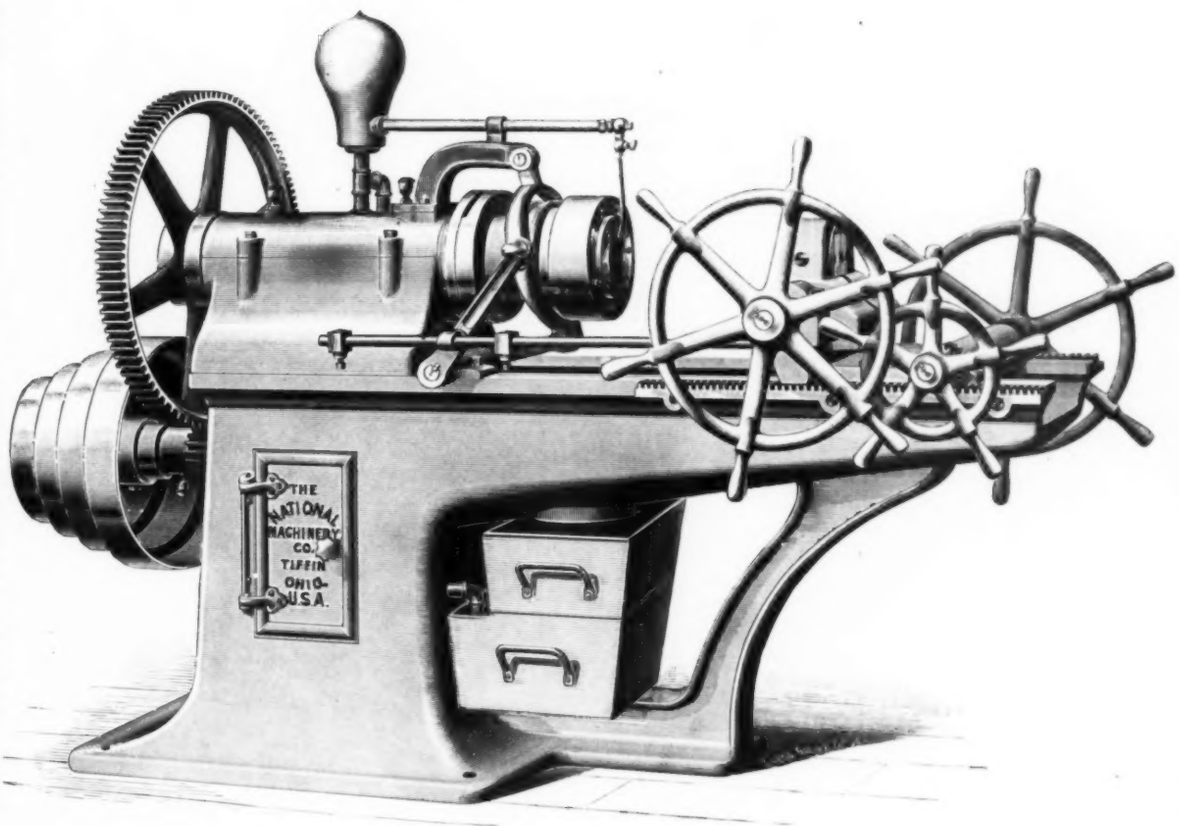
High Efficiency **Best Value**

A COMPLETE LINE OF

BOLT AND NUT MACHINERY

FOR PROMPT DELIVERY.

SEND FOR CATALOG B.



NATIONAL MACHINERY CO.

TIFFIN, OHIO, U.S.A.

In the Heart of the Oak Bark Region

Right in the midst of the finest Oak Forests of the world, on the State Line between Virginia and Tennessee,

Our Dixie Tannery

turns out more than 100,000 of the best and heaviest belting butts that the best oak bark and the most modern methods can produce, for exclusive use in Schieren Belting. Perhaps that's one reason why Schieren Belting is used by the most exacting belt users in all Christendom. Send for our Handsome Catalog and for Leatherine Literature.

Chas. A. Schieren & Co.

41 Ferry Street, New York, U.S.A.

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PITTSBURG: 238 Third Ave.
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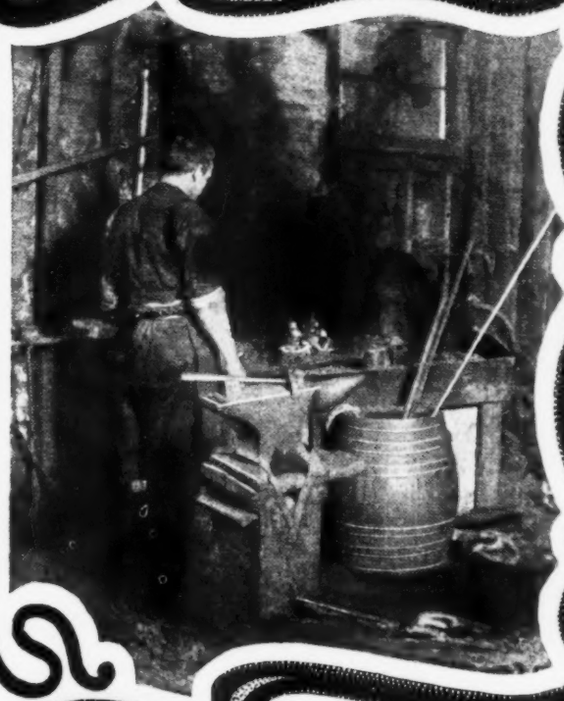
The Old Way and the New



The Old Way

Stood for dirt, disorder and darkness, smoke and soot, gas and grief. It subjected the smith to unnecessary heat in the summer, kept him full of poisonous gas in the winter, when doors and windows had to be closed, and discredited the forge shop all the time through its disorderly condition. It decreased the productive capacity of every man who came in contact with it. It drew well yesterday and poorly to-day. It was an offense to every sense but that of hearing, and a continued source of trouble and expense. It is high time to cut out the old way and inaugurate the new.

The New Way

Is different. All the smoke and gas is sucked down and out through underground pipes, where it can't hurt anything or anybody. No overhead pipes to get stopped up or obstruct the light. It's indestructible—its first cost is practically its whole cost. It keeps the temperature down and the spirits of the workmen up—keeps the forge-shop out of the smoke-house class, and makes for increased production. Adequate blast—thorough exhaust. Different sizes and styles for different purposes. The Forge Book goes thoroughly into detail—names users, too. Send for it to-day.

Buffalo Forge Company, Buffalo, N.Y., U.S.A.

American Machinist

Perkins Powerful Power Presses Produce a Practically Perfect Product and Pleasing Profits.

We don't say it that way for its alliterative effect, but because it's a clear and concise statement of a fact.

We don't claim to make the only good Presses, but we do claim, with the full approval of some of the most experienced users, that we build the largest and most comprehensive line of Presses, and that Perkins Power Presses are stronger, pound for pound, than any other. We reiterate these claims to impress them on your memory and induce you to apply the test of use, which will quickly prove them.

We build, regularly, more than 200 patterns, some of which are generally regarded by other builders as "special," and we build special presses on special order.

On the three following pages are shown some Presses representative of our regular line—just a bare suggestion of what we do as Power Press Specialists.

If the Press you want isn't shown, the patterns for it are pretty sure to be here in our shops, and you may make a serious and costly mistake if you place your order without finding out what we can do for you.

When in New York look in on the Prentiss Tool & Supply Co., at 115 Liberty St., and they'll show you what we mean by "Perkins Powerful Power Presses."

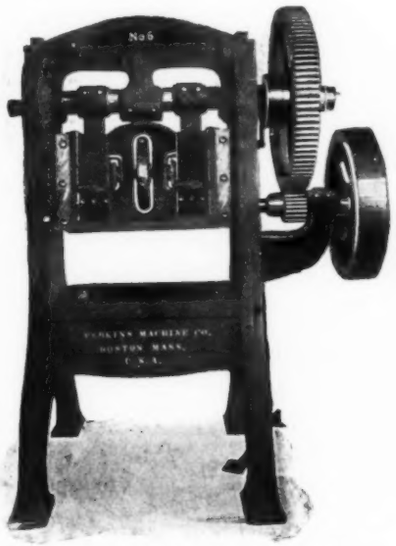
If you happen to be in London, Eng., you'll find them at C. W. Burton, Griffiths & Co.'s.

But you'd better write for our Catalog just the minute you've finished looking at the next three pages.

Now, then, have a look at the opposite page.

Perkins Machine Co.,

South Boston, Mass., U.S.A.

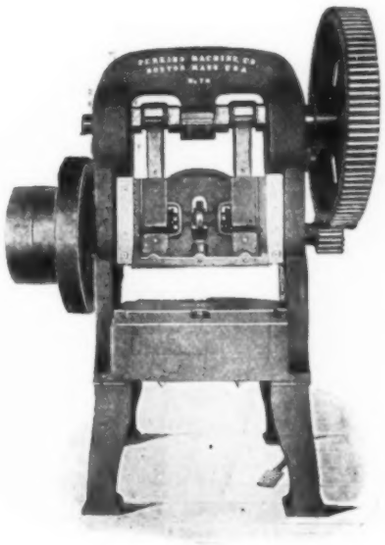


This One Is Model "I," it's for heavy blanking, one of our seven models. It weighs 4,800 lbs. Other sizes, from 2,500 to 15,000 lbs.

"If you don't see what you want, ask for it."

If we haven't it we'll make it.

If we make it, we'll make it right, and it won't cost a cent more than it ought to.



Model "I," No. 7, Geared, weighs 6,000 lbs. It has micrometer adjustment, special stroke of plunger, 3", and a ravenous appetite for metal.

STOCK AT

Prentiss Tool & Supply Co.

115 Liberty St., New York.

Perkins Machine Company, So. Boston, Mass.

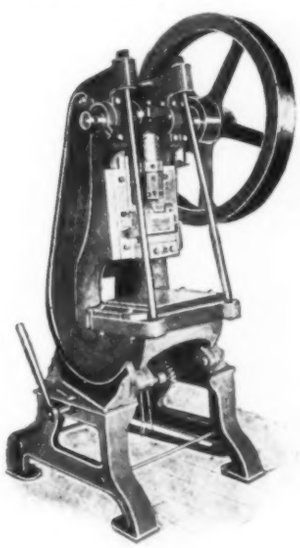
C. W. Burton, Griffiths & Co.,
London, England.

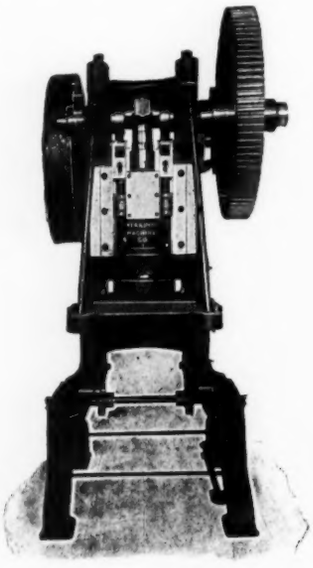
Model "A," No. 7, Geared, is a standard press able and willing to punch 2" holes in ⅝" stock, twenty-four hours per day. It's the most powerful press of its weight in the business.

Being specialists in Power Presses for all purposes, and offering a line of 200 different models from which to choose, it would seem unnecessary, if not a downright waste of time, for you to "shop around" very much.

If you don't see what you want on this page, there are four more on the next one.

Model "B," No. 40, describes another metal-eater, weighing 2,200 lbs. Some people seem to think they can't get along without it, and we think pretty well of it ourselves.





Double-Acting Press No. 25, Model "DB," tips the scales at about 2,500 pounds, and has a cam lift. Built in other sizes from 600 to 7,000 lbs.

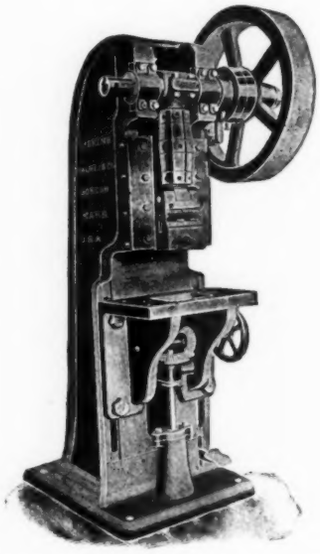
It would take fifty paqes of the American Machinist, with four cuts on each paqe, to illustrate our regular line of Power Presses.

And every one of these 200 patterns represents a successful machine, not an untried experiment.

STOCK AT

Prentiss Tool & Supply Co.,

115 Liberty St., New York.



Model "G," No. 25, is in the 3,000 lb. class. It has an adjustable bed, and, according to its users, is "the only one" on some sorts of work.

Perkins Machine Company, So. Boston, Mass.

C. W. Burton, Griffiths & Co.,
London, England.

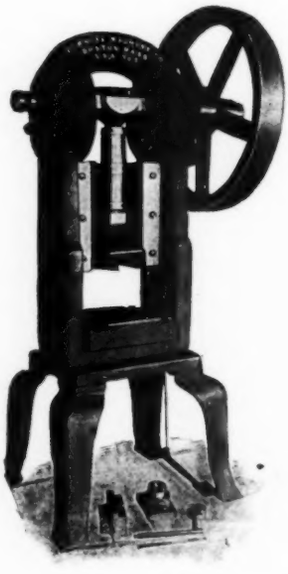
Model "C," No. 35, will punch 7½" in $\frac{3}{32}$" machinery steel, or 3" in ⅛". Has a hollow base, an opening in back, and work can be fed from front to rear or right to left. Solid frame if you prefer, and any weight from 300 to 6,800 lbs.

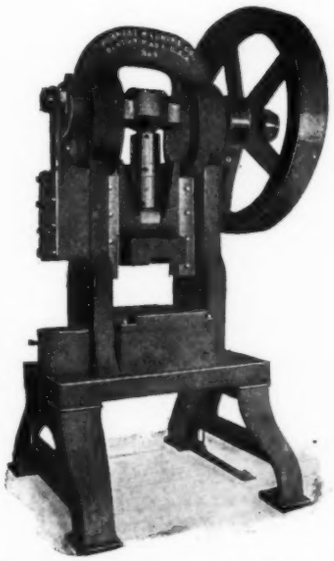
While Perkins Power Presses are stronger, weight for weight, than any others, of course you can overload them.

But that'll never hurt them, because the belt will slip and the tool won't even attempt a job that's beyond its strength.

If we haven't yet shown the Press you need, there are four more over across on the next paqe.

Model "I," No. 5, is just a plain power press without any frills and very business-like. Weighs 2,500 lbs. Build them up to 15,000 lbs.





Then here's Model "I," No. 9, a 9,500-pounder with a die bed 20″ x 22″, a 12″ x 13″ plunger and a bolster plate 22″ x 24″, 3½″ thick. Has a 9″ hole in the bed, a 3″ plunger stroke and a 4″ adjustment. There are 22″ between housings, plunger is 24″ long, and it's 12″ from bed to plunger with plunger up.

Our prices are just such prices as you would expect to pay for a good Press.

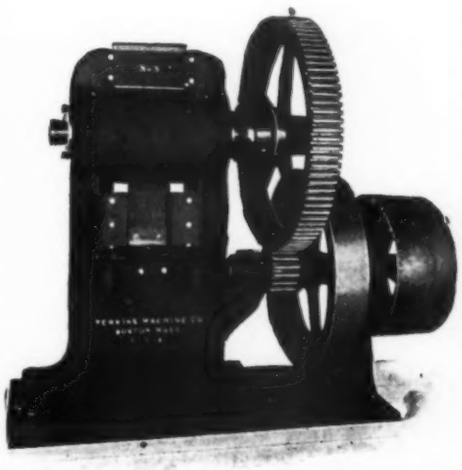
They are based on costs that are carefully kept down, not by skimping in materials or workmanship, but by modern time and labor-saving methods.

They are but little, if any, higher than you would pay for the next best, and you cannot buy better at any price.

STOCK AT

Prentiss Tool & Supply Co.

115 Liberty St., New York.

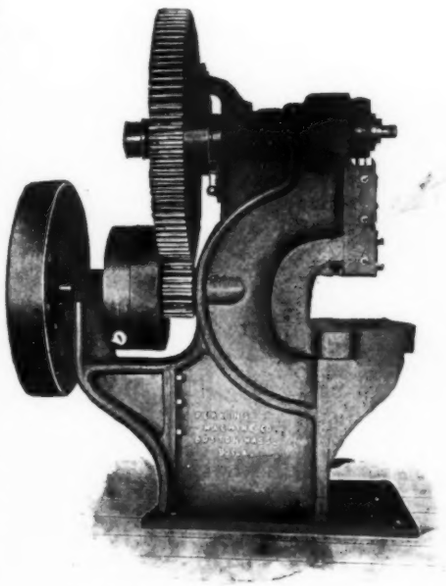


This innocent looking affair is a Guillotine Shear with a record for cutting up dreadfully. It will lop off a bar of 2½″ steel in short order. It has a solid eccentric shaft and is a very powerful tool. Built in three sizes, from 600 to 15,000 lbs., and built in Perkins' peculiar way.

Perkins Machine Company, So. Boston, Mass.

C. W. Burton, Griffiths & Co.,
London, England.

Model "E," No. 48, Geared Press, weighs 10,000 lbs. and is just as good as it looks. We build it in other sizes, all the way down to 800 lbs. It's specialty is light and heavy punching, and lots of it.

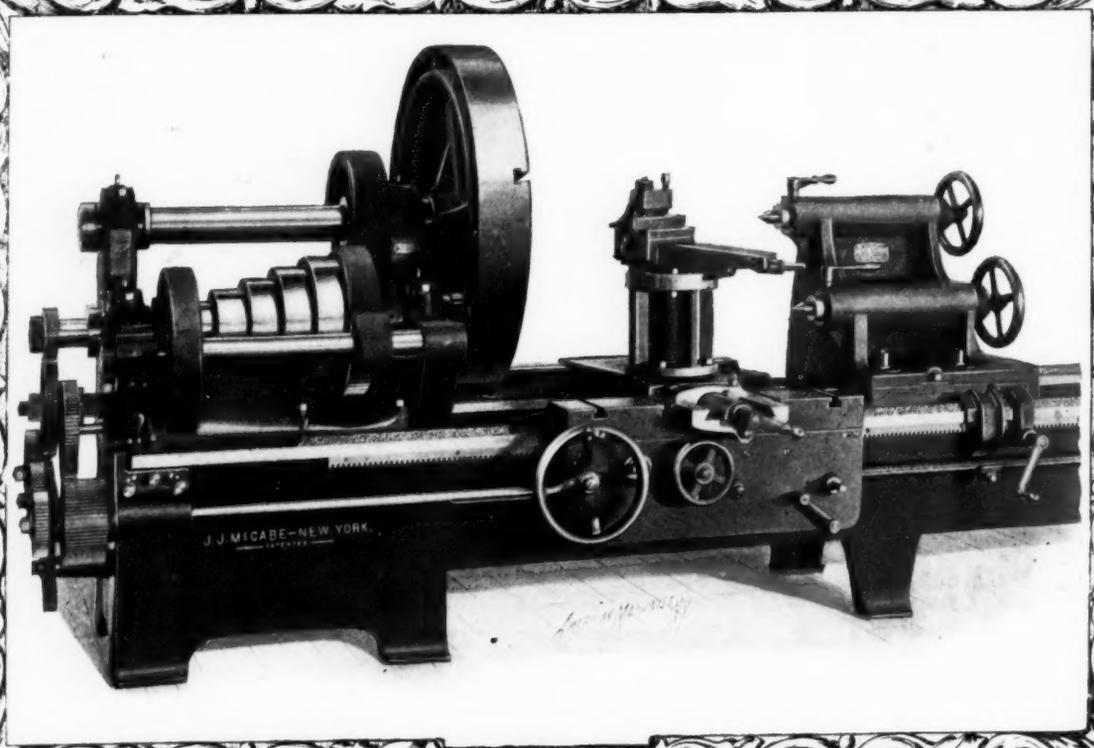


We have shown you twelve Perkins Presses.

If you'd like to see another twelve, or twelve times twelve, just tell us what you need and we'll show you what we can do for you by showing what we have done for others.

"Put not off until to-morrow that which should be done to-day."

Model "B," No. 70, **is all right**, so the large tin manufacturers say. Weighs 7,500 lbs. Bolster plate is 30″ x 33″. Stroke of plunger 2½″. Bed to bottom of slide when stroke and adjustment are up, 11″. Between standards, 26″. Back from center of slide, 15″, 26″ opening in bed. All sizes down to 500 lbs.



All I Ask Is The Opportunity To

prove the value of my "New Style" Heavy Pattern 26″-48″ Double-Spindle Lathe for your shop on your own work. This Double-Spindle Lathe of mine is really two lathes in one—one being 26″ swing with Back-gears, and all the modern conveniences for ordinary work, and the other a 48″ swing Triple-geared, or with Geared Face-plate (Ratio 72 to 1) for the occasional large jobs, where it wouldn't pay to have a heavy regular style lathe **that costs almost double.** This Lathe of mine fixes things so that the large work can be taken care of, and you still have a lathe for everyday work. As for accuracy and rapidity, there are no lathes better. In design, workmanship and material it is the peer of any. It's a lathe that you can keep busy all the time, from morning to night, on one thing and another, and if you'll give me half a chance I'll demonstrate its worth to you in a few minutes. 'Tisn't an experiment, 'tisn't the result of a notion, it comes from hard, careful study of a condition which has needed a change and I've made the change, that's all. On the other page are a few details.

J. J. McCabe, Fourteen Dey St., New York City.

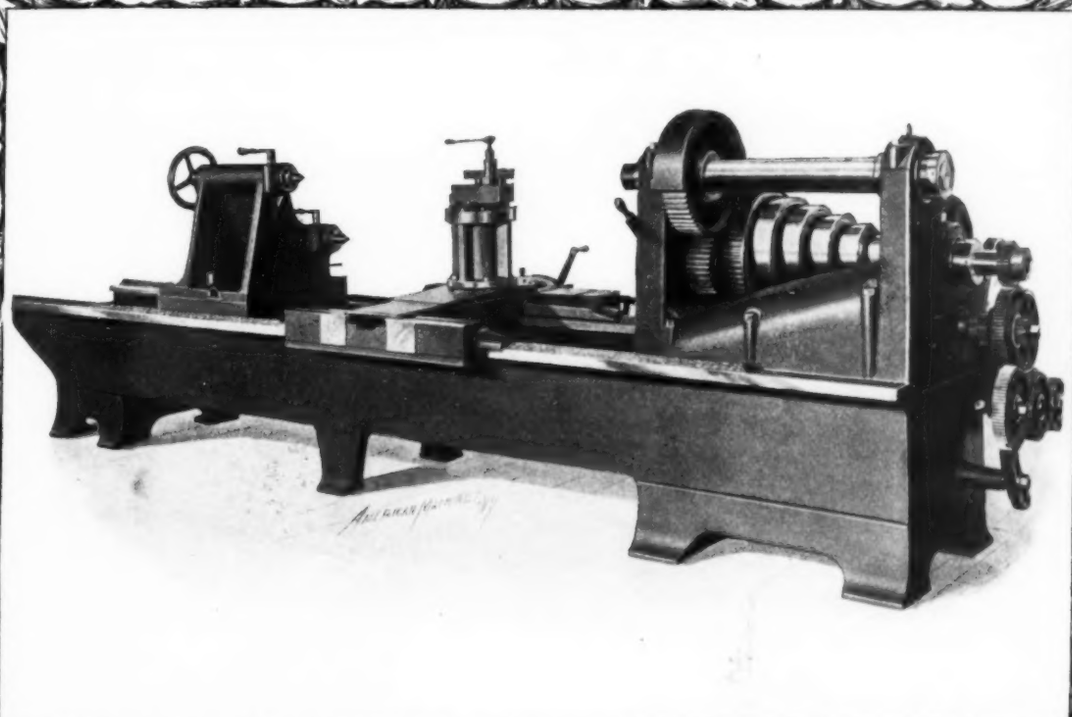
FOREIGN AGENTS—Schuchardt & Schutte, Berlin, Vienna, Brussels, St. Petersburg, Stockholm and Cologne. Chas. Churchill & Co., London, Birmingham, Manchester and Glasgow

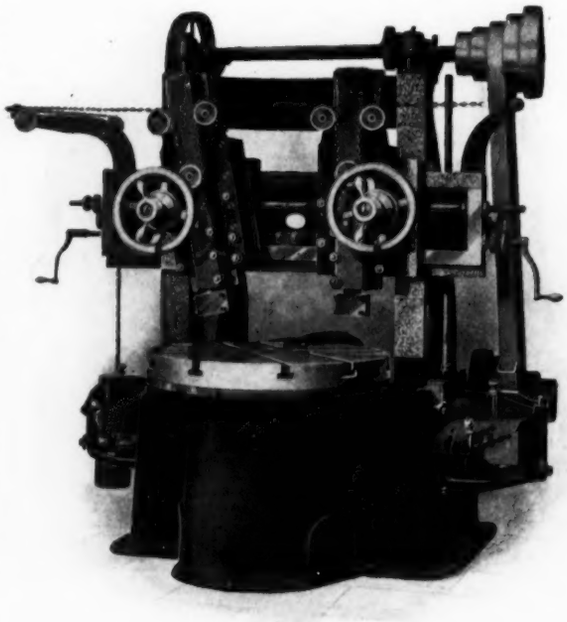
Some Details of My D. S. Lathe

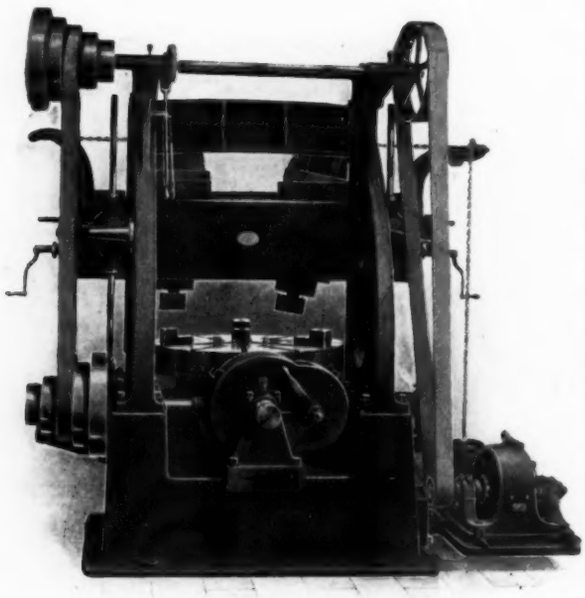
Swing over bed on upper spindle 44 in., over the wings of carriage 46 in., and over carriage 40 in. Bed is wide so that head- or tail-stock do not overhang. Boxes are of hard bronze; spindles are large in diameter and made from 45% carbon hammered steel, accurately ground. Lower spindle has 2⅛-in. hole all the way thro', upper spindle is solid. Cone has five steps; drives by a 3½-in. double belt. Gearing is strongly proportioned thro'out, wide faced and accurately cut. Lower spindle is back geared, upper spindle triple geared, or can be furnished with geared face-plate (ratio 72 to 1). Screw cutting range is double that of an ordinary lathe. Screws may be cut from one thread in four inches to 32 threads in one inch. Reverse is in the apron and operates by lever within easy reach. All sliding surfaces are carefully scraped, cylindrically finished by grinding. Every Lathe has its severe test before leaving the works. Full details we are pleased to send.

J. J. McCabe, Fourteen Dey St., New York City.

FOREIGN AGENTS—Schuchardt & Schutte, Berlin, Vienna, Brussels, St. Petersburg, Stockholm and Cologne. Chas. Churchill & Co., London, Birmingham, Manchester and Glasgow.





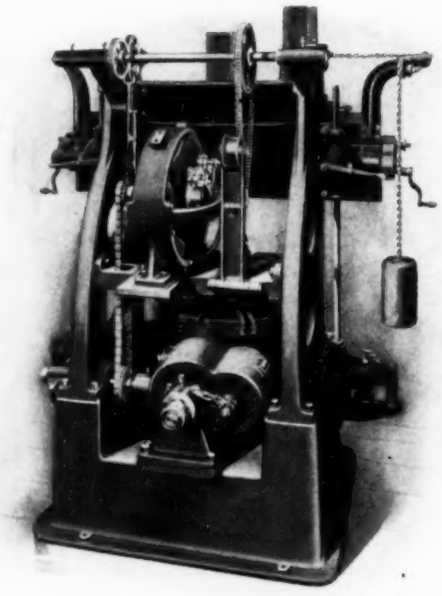


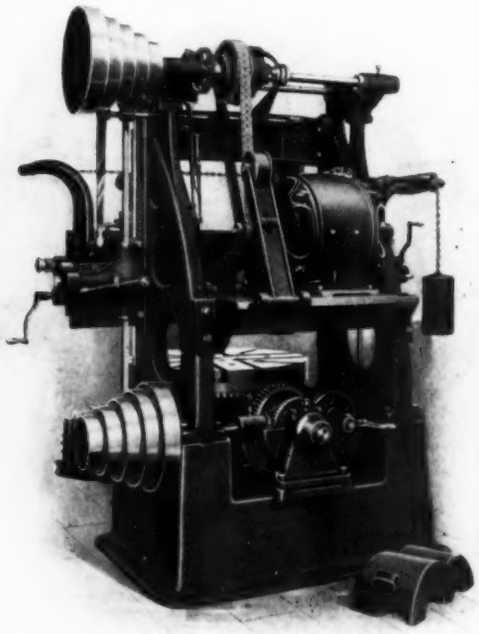
37" Boring and Turning Mill.

Here shown is our 37" Mill, with various applications of electric drive, each application serving a special and distinct purpose. Bullard Mills are so made that motors may be attached at any time, easily and quickly. It is the intelligent attention given to things of this kind that has made Bullard Tools famous wherever seen or used. No one ever made a mistake in purchasing Bullard Tools and for proof of this we refer to users.

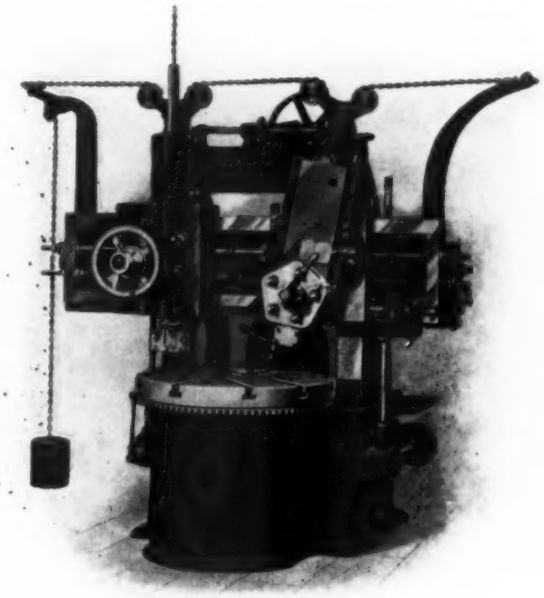
The Bullard Machine Tool Co.

BRIDGEPORT, CONN., U.S.A.





The Boring Mills Built by Bullard



42-INCH MILL, WITH ONE SWIVEL TURRET HEAD AND ONE FIXED HEAD.

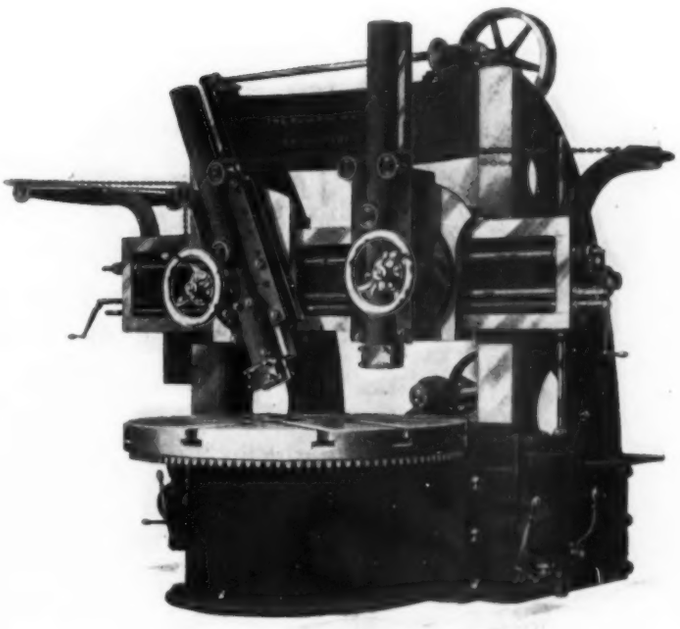
have come to acknowledged merit and general, all around boring-mill satisfaction, thro' a determination to make them so. They are the result of careful, painstaking effort for eighteen years. They are of demonstrated and proven worth in the handling of boring mill work; have renown for accuracy and rapidity; have everything you have ever hoped for in a boring mill.

They are built in sizes from 30″ up to 76″ and 100″.

They cover every possibility in boring machine work down to the last small requisite. The many features of merit have exposition, and examples of many operations which may be performed, in our

"Treatise on Boring and Turning Mills,"

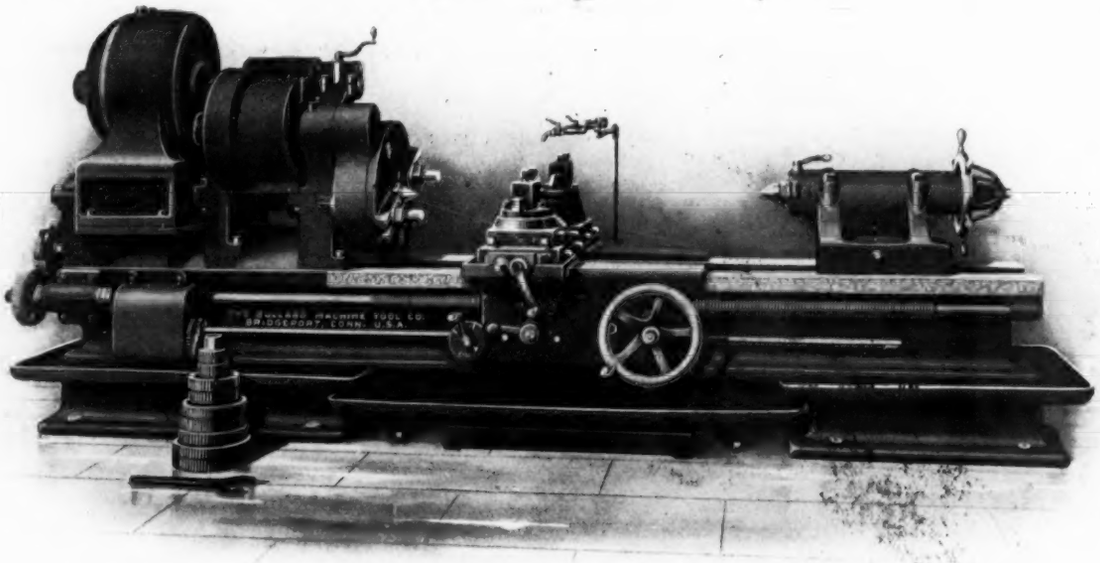
which is sent free to any address. Your careful criticisms and consideration are invited, all to the end that you have proper boring mill equipment.



62-INCH MILL, WITH TWO HEADS.

The Bullard Machine Tool Co. BRIDGEPORT, CONN., U.S.A.

New York Office, 95 Liberty St. Brown & Zortman Machinery Co., Pittsburg. Marshall & Huschart Machinery Co., Chicago, Cleveland. The C. H. Wood Co., Syracuse, N. Y. Harron, Rickard & McCone, San Francisco, Cal. Ludw. Loewe & Co., Ltd., 30-32 Farringdon Road, London, England. Schuchardt & Schutte, Berlin, Cologne, Vienna, Brussels, Stockholm, St. Petersburg.



26" Rapid Reduction Lathe

Designed especially for rapid roughing cuts and the use of high speed cutting steel. This is a lathe of radical departure from existing design, made necessary thro' the inability of the ordinary lathe to handle roughing work as rapidly as it can and should be done. On actual every-day work this lathe has shown a saving of from a 10th to a 5th of former cost. Lubrication is by ring oiling bearings, ordinary methods being wholly inadequate. Is driven by belt or motor as desired. Provision is made for a plentiful supply of cutting lubricant—from four to five gallons per minute being passed over the tools. This is a lathe for handling the very hardest sort of work in the fastest and most convenient way. It has had building looking to this end. The points where strain might come have been carefully safeguarded. Metal enough has been used to insure stability and freedom from vibration. We shall be pleased to have your inquiries.

You will find a fuller description in the reading columns of this issue of the American Machinist.

The Bullard Machine Tool Co. BRIDGEPORT, CONN., U.S.A.

New York Office, 95 Liberty Street. Brown & Zortman Machinery Co., Pittsburg. Marshall & Huschart Machinery Co., Chicago, Cleveland. The C. H Wood Co., Syracuse, N.Y. Harron Rickard & McCone, San Francisco, Cal. Ludw Loewe & Co., Ltd., 30-39 Farringdon Road London, England. Schuchardt & Schutte, Berlin, Cologne, Vienna, Brussels, Stockholm, St. Petersburg.

Thirty Days Hath November.

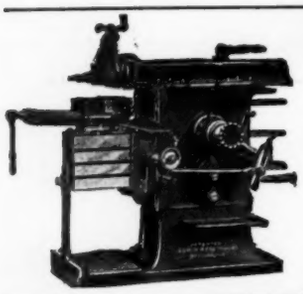
The Centaur, Sagittarius, am I,
Born of Ixion's and the cloud's embrace;
With sounding hoofs across the earth I fly,
A steed Thessalian with a human face.
Sharp winds the arrows are with which I chase
The leaves, half dead already with affright;
I shroud myself in gloom; and to the race
Of mortals bring nor comfort nor delight.
—*Henry W. Longfellow.*

Comfort and delight await all mortals using Genuine Morse Drills.—M. T. D. & M. Co.

D.M.	D.W.	Aspects.	*Our hands are full of business.* —*Henry IV.*
1	Sa.		Drills—Bit Point.
2	S.		
3	M.	*As clear as yonder Venus in her glimmering sphere.* —*Mid. N. Dream.*	Drills—Bit Point with Solid Counterbore.
4	Tu.		Drills—Bit Point with Adj. Counterbore.
5	W.		Drills—Bit Point, Special Styles.
6	Th.		Drills—Pod.
7	Fr.		Drills—Bit Stock.
8	Sa.	*Raging wind blows up incessant showers, and when the rage allays, the rain begins.* —*Henry VI.*	Drills—Center.
9	S.		
10	M.		Drills—fitting Coe's Press.
11	Tu.		Drills—Combined Taps and
12	W.		Drills—Four-Groove.
13	Th.	*Believe me, 'tis very cold; the wind is northerly.* —*Hamlet.*	Drills—with Grooved Shanks.
14	Fr.		Drills—Hollow for deep drilling.
15	Sa.		Drills—Jewelers'.
16	S.		
17	M.		Drills—Jobbers'.
18	Tu.	*Small showers last long, but sudden storms are short.* —*Richard II.*	Drills—Letter and Wire.
19	W.		Drills—Morse Taper.
20	Th.		Drills—with Oil Holes.
21	Fr.		Drills—fitting Prentice Press.
22	Sa.		Drills—in Sets.
23	S.	*Such groans of roaring wind and rain, I never remember to have heard.* —*King Lear.*	
24	M.		Drills—Shade Roller.
25	Tu.		Drills—fitting Silver and Deming's Press.
26	W.		Drills—Straight Shank.
27	Th.	*When icicles hang by the wall.* —*Love's Labor Lost.*	Drills—Straightway.
28	Fr.		Drills—Three-Groove.
29	Sa.		Drills—Taper Square Shank.
30	S.		

Morse Twist Drill & Machine Company

New Bedford, Mass., U. S. A.



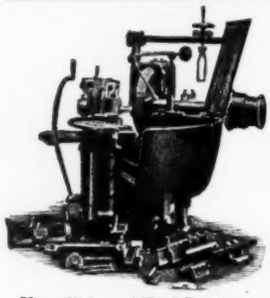
GOULD & EBERHARDT

NEWARK, N. J., U.S.A.

Automatic Gear Cutting Machinery, Shapers, Drill Presses.

HIGH CLASS MACHINE TOOLS.

If interested, our Catalog gives details.



No. 2 Universal Tool Grinder.

William Sellers & Co. Incorp.

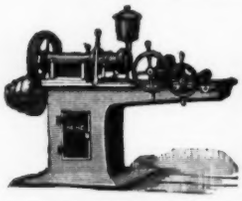
PHILADELPHIA, PA.

Universal Tool Grinder No. 1.

NOTE—By means of this machine rough forgings are quickly converted into finished cutting tools accurately ground. It is conceded that this machine has revolutionized the methods of grinding tools in the largest establishments. Send for pamphlet.

THE ACME MACHINERY CO.,

CLEVELAND, OHIO.



Manufacturers of

Acme Bolt and Rivet Headers,

Acme Single, Double and Triple Automatic Bolt Cutters.

Cutting from 1-8 in. to 6 in. diameter.

Also Separate Heads and Dies.

CONTRACT WORK

PROMPT ACCURATE SATISFACTORY

The Blanchard Mach. Co.

BOSTON, MASS.

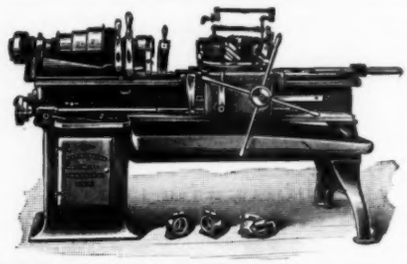
THE BALL BEARING COMPANY,

(Formerly of Boston)

2322 MARKET ST., PHILADELPHIA, PA

MANUFACTURERS OF

ANTI-FRICTION BEARINGS.



THE FLAT TURRET LATHE.

Does Lathe work accurately up to 2 in. diameter by 24 in. long.

JONES & LAMSON MACHINE CO.

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SHULTZ PATENT SABLE RAWHIDE BELTING.
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SHULTZ'S PATENT PULLEY COVER.
BELT DRESSING AND BELT CEMENT.
DYNAMO BELTING.

Export Trade a Specialty. ST LOUIS, MO., U.S.A.

The Binsse Horizontal Boring Machine.

THE BINSSE MACHINE CO., Newark, N. J.

Sole Agents.—Prentiss Tool and Supply Co., New York, Boston, Buffalo. Brown & Zortman Machinery Co., Pittsburg, Pa. Marshall & Huschart Machinery Co., Chicago, Cleveland, Cincinnati. British Empire. Ludw. Loewe & Co., Ltd., London. Fenwick Freres & Co., Paris.

21 years ago—

we started to build Planers; and for the past twelve years we've been manufacturing Planers as an exclusive specialty —Planers only—nothing but Planers.

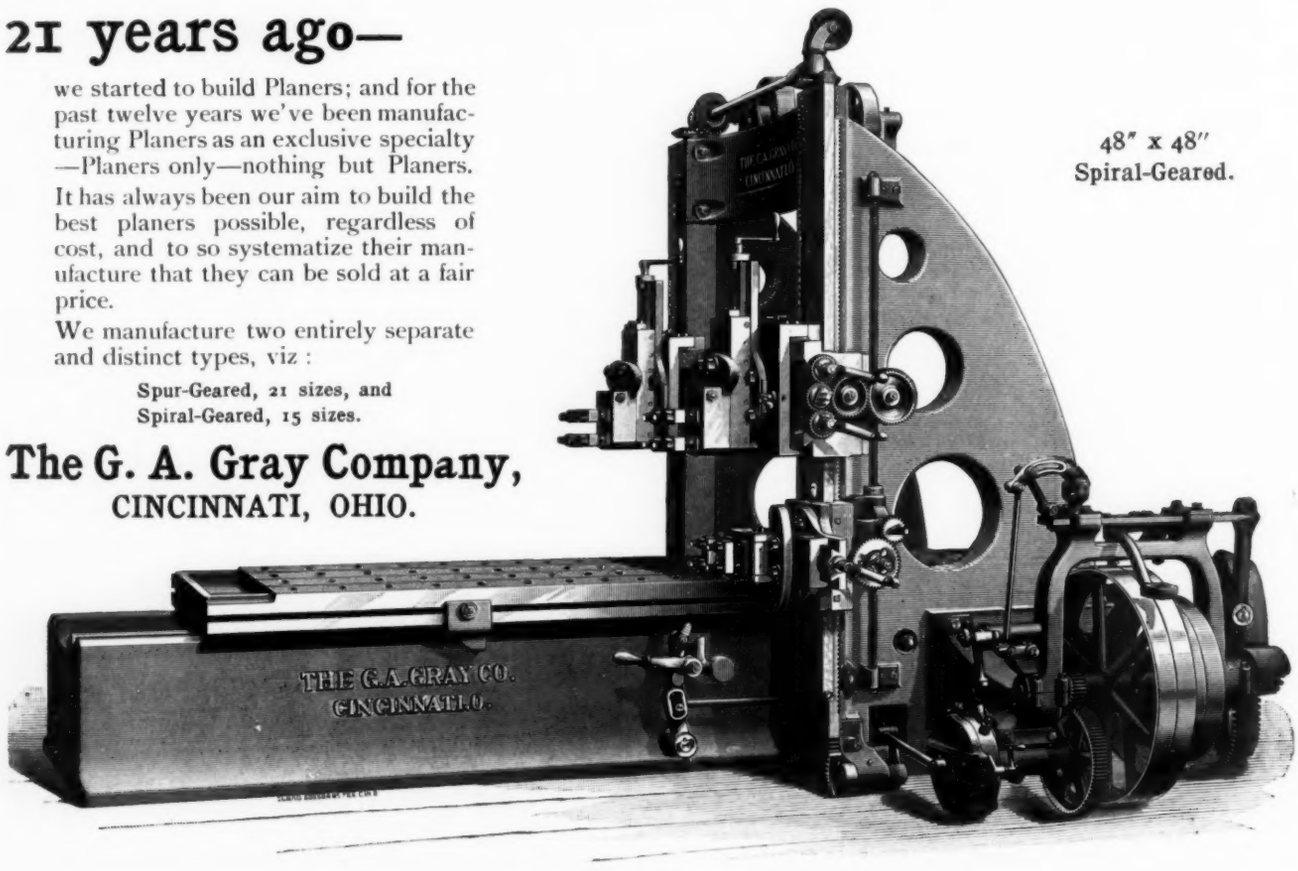
It has always been our aim to build the best planers possible, regardless of cost, and to so systematize their manufacture that they can be sold at a fair price.

We manufacture two entirely separate and distinct types, viz :

Spur-Geared, 21 sizes, and
Spiral-Geared, 15 sizes.

The G. A. Gray Company,

CINCINNATI, OHIO.

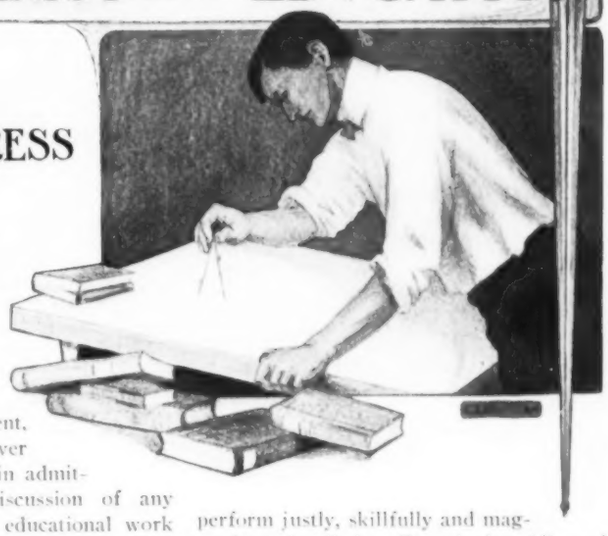


48" x 48"
Spiral-Geared.

THE AMERICAN MACHINIST AND EDUCATION

THE RETROSPECT OF A QUARTER-CENTURY OF PROGRESS

BY ROBERT H. THURSTON.



Something over twenty-five years ago, the projectors and original proprietors of the AMERICAN MACHINIST consulted the writer regarding the outlook and the best methods of cultivating what was then a comparatively new field. It was proposed to restrict the work of the new periodical to a strictly circumscribed area of the mechanical field and to cultivate that section intensely and with serious care. It was thought that the paper could be made not only successful in the usual sense—that it might combine mutual advantage to its publishers and its readers in the usual manner—but that it also might be made an educational medium of importance. That anticipation has been realized; it has been a power for good in many ways for now a quarter of a century, and its success as an educator in the science as well as the art of machine construction, in ethics and in economics, has been all that its most sanguine friends in those early days could have hoped for. It has taught good design; the best methods of construction; the essential principles of mechanical engineering which underlie the work of the designer and the constructor and also the financial side of the business. It has promoted an understanding of the right methods of doing business as between man and man; between the skillful hands and the fruitful brain; between the shop and the office; between the mind which directs and that which executes. It has taught the fundamental principles of successful manufacturing and profitable business and has done a splendid work in forwarding the whole industrial system.

A quarter of a century ago, our whole modern world was in a state of transition, industrially, and in the work that has been done since that time, and which has proved so wonderfully productive of advantage to the people of the country, the AMERICAN MACHINIST immediately took its place and assumed a prominent part. Its success was assured at once by its initiation of improved methods of journalism in its special field. At that time specialization was understood only by a few leading minds and the desirability of confining one's efforts to a limited and well-understood task and of performing that task well—of, in other words, doing expert rather than amateur work—was not as well recognized as it came to be later. The management of the new publication sought to secure expert work in every department and to offer its readers facts, principles and real information, sound thought and right methods. Infallibility was not claimed, an error was never made a precedent, and no hesitation was ever felt in correcting it or in admitting absolutely free discussion of any doubtful question. An educational work of great importance was thus carried on.

Meantime, the mechanical engineering and the technical work generally of the country was in its incipiency as a scientific system and there was opportunity to aid effectively in promoting that side of education which the Germans and the French had generations before established and then improved. Science was to be made the solid and safe foundation of every art and scientific, exact, certain deduction was to take the place of rule-of-thumb and intuition, without, however, ignoring the latter as a helpful guide. The schools were doing little to help on the education of the people for their life work and the few technical schools existing were feeling their way with difficulty toward their ideals. They had no precedents, for the American could not adopt the ways of Europe. Technical schools, like the colleges, then as well as now, were poor and struggling to offer suitable education while unable to offer suitable inducements to able men who, only, should be entrusted with educational work. The missionary spirit was the main incentive with those entering upon the work and, as in all missionary work, its promoters were necessarily mendicant, entreating private charity where they should have found State support and public honor above all men.

Then, as now, legislators were not always statesmen and the most statesmanlike of them had not begun to realize that, as Wendell Phillips once said, "education is the only interest worthy the deep, controlling anxiety of thoughtful men," or that, as Mr. Carnegie once said, in effect, their duty was "to make our young men fit to be American citizens," not to try to "make poor imitations of Greeks and Romans." Milton's definition of education was recognized by few educators or legislators, nor was it known to even the rare statesman: "I call a complete and generous education that which fits a man to perform justly, skillfully and magnanimously all the offices, both public and private, of peace and war."

Germany was, and in fact still is, the only nation in which the majority of legislators were statesmen recognizing this Miltonian proverb, in which the executive officers of governments, national, provincial and municipal, were at once wise enough and brave enough and firm enough to undertake reform and to provide for the people the various educations which they needed.

In the United States a feeble beginning had been made and every auxiliary was needed. The new periodical proved one of the most useful and reliable of such auxiliaries and, allied with the technical and professional engineering schools, the "Land Grant Colleges" and the "institutes" springing up in the large cities and offering technical and trade education, it worked always and harmoniously with the best elements of the modern educational system which has been gradually, slowly but steadily evolving forms meeting the needs of the people.

To-day the nations of Europe are frankly admitting the value of the industrial and manufacturing methods common in our country. American tools, American systems of piece-work and of liberal compensation of every man in proportion to his earning power, his skill and his industry; American systems of organization of workshops and of industrial establishments; American products—tools, machinery of all kinds, agricultural, mechanical and power-producing: all are finding favor and imitation throughout the world, sometimes not altogether pleasing but often most gratifying and satisfying.

The literature of the mechanical and engineering departments of industry has come to be extensive and is constantly growing in quantity and quality at an accelerated rate. Its character has greatly changed and the most important problems

of the mechanic, the constructor and the engineer are now capable of scientific and exact solution, and the sporadic production of improved devices and of "inventions" by the amateur genius is largely superseded by the deliberate and exact study of the problem of improvement by the designer, by his precise definition of the conditions to be met and by his scientific and accurate solution of his problems. The art of exact design, based upon scientific principles and experimentally determined, accurate data, is the modern expert's method of supersedure of the older ways of the amateur inventor. This now usual system was exemplified by James Watt, and the perfection of his then new art and of his then new invention has been the work of the nineteenth century. In this work the AMERICAN MACHINIST has taken a part and has performed it well, aiding effectively in promotion of the literature of the new, modern world of industry.

The special treatises on scientific and industrial subjects, the encyclopedias and the text books of the technical schools and colleges, exhibit a similar change. A generation ago data were difficult to find and inexact and comparatively few men of science, or engineers, or mechanicians, were either so situated as to be able to add in any important degree to the industrially applied scientific knowledge of that time, or competent, even if having leisure, apparatus and funds. In the fields of pure science the investigators were few, the apparatus was crude and the progress made comparatively slow; while competent men of science, at once able and expert in the departments of application, were too often inclined to despise the useful; sympathizing with that overearnest classicist who exclaimed at a gathering of educators, "I hope that we may never be compelled to teach anything 'useful.'" Where there was one man, like Alfred Mayer, interested, competent and ambitious to do work at once thoroughly scientific and in maximum degree fruitful of good to all departments of life, there were then many who preferred deliberately to avoid those fields of research which promised results of benefit to the industrial system.

To-day, the most extensive, the most interesting and the most impressive and splendid work, in many departments of science, is related closely to, if not based upon, the needs of applied science and the industrial arts. Individual capitalists and business establishments are supplying funds, and often, as in the case of the railroads, themselves conducting lines of physical research or chemical investigation, in their own laboratories, to exactly determine the characteristics of the materials of construction used by them. The treatises and the text-books and the cyclopædias are rich in data of the most directly useful and valuable sort, and every scientific investigator is contributing, immediately or remotely, to the promotion of the arts as well as of the sciences. The "scientific method of science advancement," as the writer has called it,* is now become the recognized and fruitful source of modern progress in all departments of civilized life.

The scientific and the industrial periodicals are performing a great part in this work through their popularization of the rapidly aggregating acquisitions of scientific information and the principles which apply in the scientific conduct of the great industries. The progress made in the productiveness of manufacturing industries—in fact, in all industries—during the last generation is realized by everyone who can remember the conditions of business and of home-life of a grandfather's time and the figures for prices, wages and purchasing power of a day's work in any trade in the "early seventies." The mechanical and other industrial periodicals

ROBERT H. THURSTON,
Mechanical Engineer, Director of Sibley College, Cornell University.

are to-day almost universally leading the people of the country toward a definite familiarity and acquaintance with the fundamental principles of prosperity and advancement. They are practically all coming to understand and to teach that the progress of any country involves, as with individuals, the steady, industrious, skillful employment of each and of all; maintaining thus maximum production and most satisfactory quality with steady progress in the invention of new and better machinery and methods of its operation. They all teach the now recognized fact that the product of the industries of the country is substantially all supplied to the great mass of the people by whom it is produced; that all interests combine to impel steady work, by the best methods, with the best machinery and with the best possible organization of the industrial army and best equipment. This being assured, the principle is now being universally recognized by wise business men and all capable thinkers, that the fundamental business idea is the stimulation of the growth of the business by extending its market through the only correct method—that of continually reducing prices by as constantly improving machinery and methods, making each worker more productive and giving him a fair equivalent for his improved earning power. It has thus come to be seen that with these improvements, as illustrated by the greatest and most successful enterprises, come invariably increased compensation and steadier employment. The more thoroughly these principles are adhered to the higher the producing power, the better the compensation and the more continuous and satisfactory the vocation. The technical press has done a great work instilling these now well-understood principles of business success into the minds of the business men and the workers in its department, and the AMERICAN MACHINIST has taken its full share of this great work.

In the schools, the art of machine design and construction is also taught by improved methods and with vastly improved text-books and equipment. Reuleaux and his German and French confreres of a half-century ago were the pioneers in the introduction of scientific methods and scientific learning into the technical schools and in thus converting the vocation of machine design and construction into a profession. Their magnificent work has progressed so far that it has come to be asserted by educators having no personal interests in the matter that the best class of engineering schools now turn out, not simply a class of truly professional men, but that their output is the best-educated class of professional men.

The art of machine construction has thus come to be reduced to a science and the scientific method of research has further led to the provision of data regarding the character of tool steels, strength of the available materials of construction and the best methods of shaping and proportioning parts of the machine such as have increased its output in many cases many times over, reducing the costs of work performed by it to a fraction of those of the days of the first efforts of the AMERICAN MACHINIST in promotion of this progress.

It would probably be admitted that not the least, if not in fact the best, characteristic of the AMERICAN MACHINIST throughout this whole quarter-century has been its splendid maintenance of freedom and independence. In these days, when in our country freedom and independence of the individual citizen has, in spite of our century-old boasts, become in so many sections obsolete and when the right to choose a vocation, to make a mutually satisfactory bargain, to go about one's business

*Vice-President's Address, St. Louis Meeting of the American Association for Advancement of Science, 1878.

without molestation, to make one's vote effective, to choose one's ideal of a legislator, to in fact conduct oneself and make one's life freely and independently as an American citizen should, is so often denied and when the individual so seldom asserts his rights under the law, life in hand where necessary, it is a pleasure and comfort to see a journal conducted with ability, courage, fairness and discretion throughout a quarter of a century, during which the greatest changes—good usually, bad occasionally—that the civilized world has ever seen have occurred. It has declared its editorial views frankly, kindly, boldly and firmly with avowed willingness on all occasions to review its judgment, good reason being given. The right to change one's mind is always reserved by every good and wise man and all good editors.

Such has been the character of the work of this powerful influence in the industrial world, and it is this journal and such as this that must be relied upon more than perhaps any other class of periodicals to restore the freedom and independence of the citizen; to instill correct views of life and of business; to help preserve the peace; to maintain the law; to extinguish the present tendency toward toleration of mob law and compulsion of honest, law-abiding men, and to finally found permanently and solidly upon a basis of scientific and moral law the whole industrial and social structure of the nation.

Our main business, in this life and so far as concerns this life, is to do what we can to free ourselves and our fellows from the trammels of ignorance and crime—which is usually physical disability, largely due to ignorance and folly of an earlier generation—and from the handicap of poverty, and to raise our own generation and its posterity, so far as example and precept may, to higher levels of existence. In this business we are making rapid progress to-day through the promulgation of correct ideas of ethics, the acquirement of scientific knowledge, the establishment of right industrial methods, the helping of all citizens, first to assured individual and absolute fredom to do each his best; second, to give each opportunity to make himself in maximum degree useful to himself—which ultimately means to others, right methods being adopted; thirdly, to promote the education of the youth of the nation, and, finally, to make the adult entering productive life free to select his best work and to fit himself best to do his part in the world, steadily and more and more profitably to himself and his country. The work of men of science, industrial generals and privates, educators and spiritual leaders; men of capital, of skill, of ability, men of the masses, each in his place and to the best of his ability, all should and, if the law is maintained and the peace preserved, all will, conspire to the same great end—and the press, of all agencies, influences all most powerfully. The AMERICAN MACHINIST, the Reuleaux, the contemporary Watts and Faradays and Greeleys and Adam Smiths and every good mechanic are working together for the best interests of the country. May they long continue their good work!

How Local Industries Have Begun.

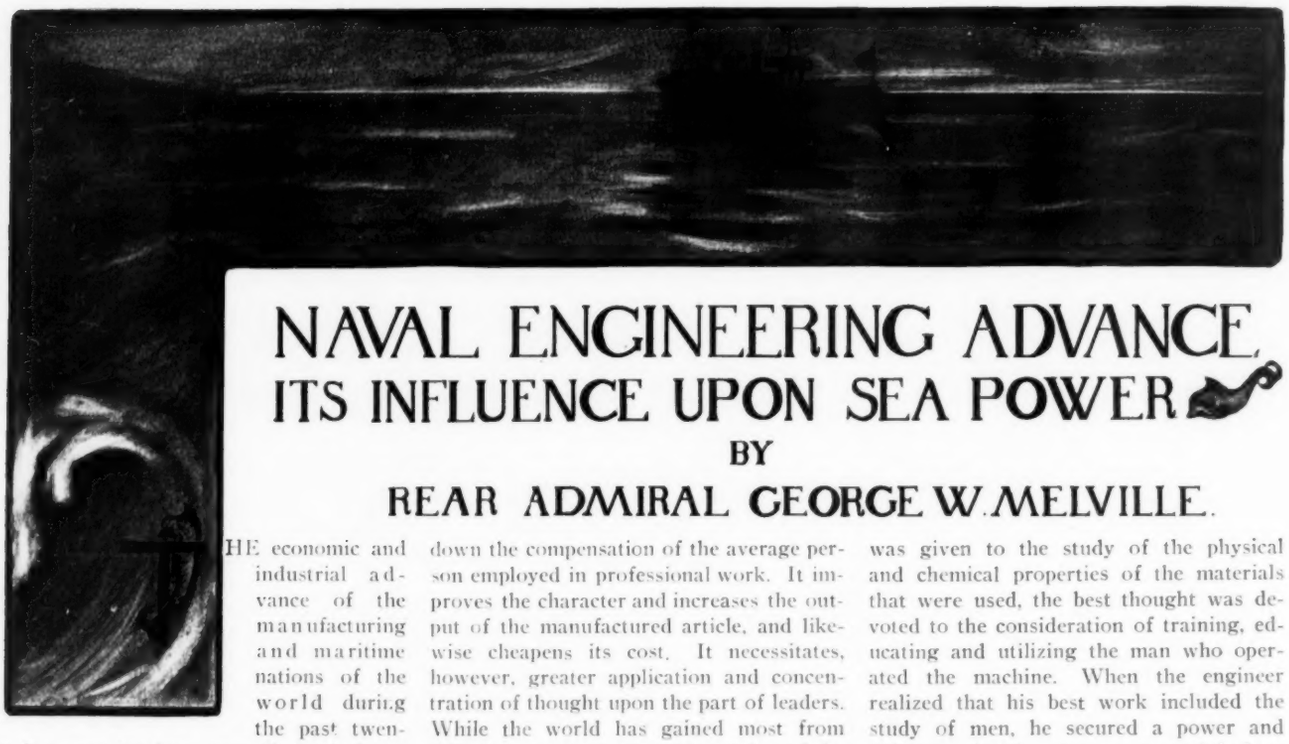
In most cases it will be found that the original establishment of an industry in a locality was largely a matter of chance. The shoe industry in Lynn, Mass., is a case in point. In the early colonial days this settlement had its quota of cobblers, who made as well as repaired the shoes for the region thereabout, but did not attempt a broader market. In 1750, however, John Adams Dagyr, a Welshman, and a skilled shoemaker, settled in Lynn and began to teach his apprentices the art of fine shoemaking. It soon became known that shoes were being made in Lynn nearly as good as the best made abroad, and as early as 1764 Dagyr was spoken of in a Boston newspaper as "the celebrated shoemaker of Essex." Had this man settled in Roxbury, Mass., rather than Lynn, the bias toward shoe manufacturing might have become established in that quarter, and Roxbury instead of Lynn might to-day be one of the three great shoe centers of the United States.

The nature of many a city's industry has been shaped in just this way in the early days of its history by the decision of one man. The decision of the pioneer in an industry at a given point rests on various grounds. He establishes usually an industry with which he is familiar because of experience obtained elsewhere. Several of the above selected industries have been established in their respective localities by the emigration from Europe of individual skilled workmen or groups of skilled workmen. The town where such a man chances to settle is taken for a location of the industry in most cases without much questioning whether or not it is better adapted for it than any other town. But if he searches for a suitable place, his chance acquaintance with one locality, or the offer of a friend to assist him if he establishes there, often influences his decision at the expense of another and perhaps more suitable locality where he has never visited, or where no acquaintance appeared to offer inducements. In many instances towns offer inducements to manufacturers, such as exemption from taxation for a period of years, and such efforts have often been successful in building up an entirely new industry in the town. But if the industry is to be perpetuated and to increase in the locality, the original establishment must succeed, for it is the influence of its success which causes other establishments to spring up around it. In the early history of every industry numerous enterprises fail, not so much because of the unfitness of the locality chosen, as because of the unfitness of the man who attempts to carry on the industry at that point.—*Census Bulletin.*

Avoiding Useless Work.

While we are talking about what we have done it may be well to say a word or two about what we have not done and are not doing. We now avoid the doing of many things which once it was our habit to do, and this avoidance has contributed with the rest to our advancement. A generation ago, it must be confessed, we were doing a lot of useless work in the way of so-called ornamentation. The cost of this uselessness and the deleterious effects of it extended all through the business. The designers of machinery were not content with the most complete adaptation to function, but in addition they tried to make their machines pretty. In many cases they studied architecture and tried to embody architectural features of decoration in their designs, entailing additional and useless and worse than valueless work upon at least the draftsman, the patternmaker, the molder and the machinist. General outlines were modified and details of ornamentation were added, which, while costly to produce, generally really detracted from the strength, efficiency or convenience of manipulation and, according to our more enlightened views of to-day, added ugliness instead of beauty. We were in love with "bright work" and so spent time in machining and hand polishing large surfaces of metal, and often added strips and plates and knobs and patches of shining brass here and there for no earthly purpose except to presumably please the eye. All this increased the cost of production while adding positively and practically objectionable features. The machines of the old style were always requiring additional labor merely for keeping them bright and clean, so that all the way through it was a losing game.

All this old practice seems to us nonsense since our eyes have been opened. We have learned a different standard of beauty in machine design and we are keener admirers than ever of excellence in this direction when the newer standards warrant it. We have learned to consider to whom our decorative efforts really appeal. Earnest mechanics and engineers and pushing business men look for results and upon machines as the instruments, and the only beauty any machine can have for them is that of simplicity, strength and adaptability. Curved lines when straight ones are functionally demanded, sharp corners external or internal where round ones may be had, raised foliage and scroll work upon otherwise smooth surfaces, polished metal merely to be kept clean and looked at, gaudy painting, striping and gilding are all impertinences to those who alone are capable of admiring and appreciating the possibilities of beauty in machinery, and they are a costly feature which we happily have largely eliminated with commensurate advantage and satisfaction to all concerned.



NAVAL ENGINEERING ADVANCE, ITS INFLUENCE UPON SEA POWER

BY

REAR ADMIRAL GEORGE W. MELVILLE.

THE economic and industrial advance of the manufacturing and maritime nations of the world during the past twenty-five years has been most distinctly due to the engineering triumphs of that period. It has been the engineer who has made it possible to establish such rapid and regular transportation facilities that the granaries of the world, however remote from the sea, are now in easy and cheap communication with every part of the world where breadstuffs are required. There is hardly a phase of the new and successful business methods which are now in vogue that is not the direct or indirect outcome of the work of a technical mind.

THE DEVELOPMENT OF SPECIALIZATION.

The advance along every line of engineering work has been so rapid that it became necessary to specialize. In the accomplishment of great deeds it became evident to the engineering executive officials that the field of industrial science, like that of law, medicine and diplomacy could no longer be grasped in its entirety by one mind. The engineer was also quick to recognize the fact that the substantial rewards of the profession could be best secured by the specialist, and this may have been no small factor in inducing scientific men to concentrate thought and energy upon special lines of their work. As the general practitioner in the legal and medical professions is now the exception rather than the rule, the engineer simply kept abreast of the times in qualifying in particular directions rather than in attempting to do general scientific work.

BENEFICIAL EFFECTS OF SPECIALIZATION.

This specialization has benefited the general community whether or not it has been advantageous to the individual. It entails greater mental strain and requires closer study upon the part of the man. It brings greater reward and emoluments to the distinguished few, but it undoubtedly cuts down the compensation of the average person employed in professional work. It improves the character and increases the output of the manufactured article, and likewise cheapens its cost. It necessitates, however, greater application and concentration of thought upon the part of leaders. While the world has gained most from this change, the status and prestige of the engineering profession have greatly increased, as a result of the experimental research and special study required of the technical specialist.

This specialization was particularly beneficial to the engineer because it compelled him to assume more executive duties. It soon became apparent to the technical expert that it was necessary for him either to assume executive control or be subordinated to a leadership whose training had been of a clerical nature. As a result, there has been an increase in executive efficiency, and encouragement has been given to the development of inventive faculty. This combination of executive ability, technical talent and practical experience has developed leaders of scientific attainments, the like of which has seldom before existed in the world's industrial history.

THE DOMINANCE OF THE ENGINEER IN AN INDUSTRIAL AGE.

With the trained engineer in executive control, there have thus been developed technical administrators who do not hesitate to undertake the work of carrying to completion engineering tasks of great magnitude. By reason of the training secured by such leaders there has been developed a readiness to assume responsibility, a confidence in self, and a knowledge of details which has produced more amicable relations between employer and employee, while it has turned out work of more reliable and uniform character.

In successfully developing enterprises where specialism was the cardinal feature it was necessary to revolutionize industrial methods, and this could not have been done if the engineer had not made rather than followed precedent. While attention was given to the study of the physical and chemical properties of the materials that were used, the best thought was devoted to the consideration of training, educating and utilizing the man who operated the machine. When the engineer realized that his best work included the study of men, he secured a power and influence that he never possessed before. It was because the work of the professions of law, medicine and theology related to the study of man and not to his creations that these professions dominated the world for centuries. The profession of engineering actively competed for this supremacy when the fact was recognized that the executive engineering mind must deal with men even more than with materials and machines.

ENGINEERING TRAINING FITS ONE FOR EXECUTIVE LEADERSHIP.

With the advent of the new century the fact was apparent that the dominant power in the solution of economic questions had been transferred from the nestors of law, diplomacy and journalism to the captains of industry. This change was the natural sequence of the fact that engineering training and experience fitted one for executive command. When such leaders came to the front it was then possible to marshal thousands, and even tens of thousands of artisans under the direct management of a single technical administrator. The capabilities and resources of the mechanic were never secured until the executive engineering expert assumed control and provided means whereby such resources and talent could be utilized.

THE ENGINEER HAS BEEN RELUCTANT IN DEMANDING RECOGNITION OF HIS ACHIEVEMENTS.

The advance along particular engineering lines can be told only by experts who have specialized in such directions. The world has but little knowledge of the character and extent of the engineering work that has been actually accomplished. It has been a weakness of the engineering profession that its leaders do too little writing and too much work. Only a few

years ago the friends of an eminent lawyer urged his appointment as a member of an important engineering commission upon the grounds that a lawyer was needed to analyze the technical testimony submitted and prepare the accompanying report. It is such evidence as this which should convince engineers that the one who has wrought great performances should freely tell of his deeds, and that it is a false modesty which avoids honors which have been deservedly won.

ENGINEERING ADVANCE ALONG MARITIME AND NAVAL LINES.

As the advance made in marine and naval engineering is characteristic of that secured along other lines, it may be pertinent to briefly tell of some of the results achieved during the past twenty-five years.

The boiler pressure has increased 300 per cent., thus permitting economies to be secured by utilizing the expansive force of steam to a greater extent than could be done with low pressures. This increase in boiler pressure has had a very far-reaching effect upon naval engineering development. It has been the primary cause of the improvement in engineering material. It has compelled the marine engine designer to give increased attention to the study of efficient cylinder ratios. It has compelled the use of more cylinders, and thus a uniformity of crank effort has been secured, causing a noticeable improvement in the balancing of engines. Where there was an inefficient distribution of steam pressures, undue racking strains existed, thus submitting the working parts to shock.

The cost of carrying a ton of cargo one mile has been reduced 50 per cent. The sustained sea speed of armored ships has increased 50 per cent., while that of torpedo boats has increased 100 per cent.

The coal consumption in securing an indicated horse-power has been reduced 25 per cent. Several efficient and reliable systems of using forced draft for an indefinite period have been perfected, so that it is now possible to burn twice the amount of coal per square foot of grate that could be consumed by the same weight of boiler that was in use two decades ago.

For marine purposes the single expansion cylinder is almost a thing of the past since it has been replaced by the triple and quadruple cylinders. The single screw propeller has given way to the twin screw. It is extremely probable that economic, structural and tactical advantages will compel the use, in the future, of triple screws in battleships and in large powered merchant vessels as well.

There has been a remarkable gain in the efficiency of marine auxiliaries, due to improvements made in the character and arrangement of these appliances. Steam is not only used as a motive power, but there is required, for special purposes, the installation of electric, hydraulic and pneumatic appliances.

INCREASED EFFICIENCY AND ENDURANCE OF MACHINERY OF WARSHIPS.

Commercial demands in the maritime marine, as well as military necessities in the navy, compelled the marine engine designer to lighten machinery. By demanding of the manufacturers better material, and by a more careful study of the principles of dynamical engineering, it has been possible to gradually decrease the weight allowed for motive power, so that we are now able to develop, from a ton of marine machinery, over double the power that was secured a quarter of a century ago.

The advance in marine engineering may be well told by showing the progressive increase in size and the improvement in character of the shafting manufactured for naval and merchant vessels during the past twenty years. Shortly after the birth of the new navy, the "Dolphin," the first

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of the steel ships, broke her 13-inch shaft, and the navy was seriously embarrassed by the delay in procuring another shaft of the same size and character.

The Hamburg-American liner "Deutschland" has a shaft of nickel steel which is over 25 inches in diameter. The "Kaiser Wilhelm der Zweite" is to have engines of 39,000 horse-power, which will give her a sustained speed of 24 knots. Her shafts will exceed in diameter any heretofore manufactured. At the recent exposition in Düsseldorf, there was on exhibition a hollow shaft of crucible steel, 150.2 feet long. It is the heaviest forging made to date; made in one piece from a block nearly 176,000 pounds weight—12.79 feet long and 6.07 feet in diameter. For its manufacture there were required the contents of 1,768 crucibles, and 490 men completed the cast in about 1½ hours. The forging was done in 62 forge hours and 22 heats, and the finished forging weighed 133,840 pounds.

IMPROVED SANITATION OF SHIPS.

Through careful study of sanitary engineering conditions, the warship as well as the ocean grayhound is now about the healthiest place where one could make his abode. Ice is not only manufactured daily, but there are refrigerating rooms for preserving food and supplies. Electric blowers ventilate every part of the vessel. There is not an hour of the day when every living compartment cannot be well lighted by the pressing of a button. On many of the ships there is a fresh water service pipe which can be tapped at any time for drinking, cooking and bathing purposes.

In commenting upon the operation of the American fleet off Santiago, one of the foreign officials declared that the American sailors were as well fed and cared for as some of the Spanish generals on shore. This statement was not far from the truth, for it is an absolute fact that the ration supplied to the enlisted force of the navy is superior to that received by the average mechanic on shore. It was the work of the engineer in perfecting means of refrigeration which made it possible to supply such a ration.

IMPROVED MANEUVERING QUALITIES.

By reason of the care that has been given to the design, construction and installation of steering engines, ships are now maneuvered with precision and reliability. By the use of reliable steering engines, and the installation of triple screws, one of the latest German battleships was passed through the Kaiser Wilhelm Canal in a manner that astonished the naval experts of the Emperor's staff. By going ahead with the middle screw and backing slowly with the side screws, the vessel not only had good headway, but responded instantly to the helm, and maneuvering powers were obtained that could not have been secured with a twin-screw ship.

THE NECESSITY FOR A SKILLED AND HIGHLY TRAINED NAVAL ENGINERING PERSONNEL.

There has been likewise a marked improvement in the personnel placed in charge of marine engines. If the character and extent of the machinery of the present day is compared with that installed twenty-five years ago, then a breakdown at sea is of rare occurrence compared with what it was then. The man now at the throttle may not have more skill, endurance and physical courage, but he possesses an alertness, readiness of resource and intelligence that were not demanded of his counterpart who lived when steam was an auxiliary to sail. By reason of this skill, intelligence and courage in the engine-rooms, ships are now run with the regularity of a railroad train, and it is principally due to economic reasons if there is any failure to reach the terminal at the scheduled hour. As the coal con-

sumption is enormously increased to drive a vessel at high speed in a heavy seaway, most commanders wisely prefer to slow down under such circumstances, and thus the length of the trip is often prolonged.

The duties of the engineers on board the modern warship now include the care and operation of the searchlight on the bridge, the drainage system in the bilge, the anchor engine in the bow, the steering engine in the stern, and the management of scores of mechanical appliances in the various compartments beneath the protective deck. By actual count there are over 1,000 valves on one warship. Including all the tubing in the boilers and condensers, it has been estimated that there are over 30 miles of piping in some of the vessels. Since the duties of the line and engineer officers have been consolidated in the American Navy, the technical sea officers of the future will have to look out for the torpedoes, gun mounts and electric plant in addition to the onerous duties now devolving upon the engineers. The engineers' duties are therefore above as well as below the protective deck, and that nation will ultimately secure naval supremacy which substantially recognizes the truth of the statement made by President Roosevelt, when he declared that the "modern naval officer had to be a fighting engineer."

TREND OF NAVAL ENGINEERING ADVANCE—MARINE TURBINES.

As it is towards the future that many eyes are turned, the naval student and expert concerns himself as to the trend of the advance that can be expected along naval engineering lines. There will be progression, and already we see evidence of some successes that may be expected. It is exceedingly probable that the reciprocating engines for small high-powered vessels will give way to the marine turbine. The development of an efficient rotary engine of this description, which will at the same time have reliability and endurance, can be confidently looked for, but success will be secured only by gradual improvement and experiment. The world has a direct interest in the development of such a motor, for the following are a few of the advantages that will be secured by the use of an efficient marine turbine:

Increased speed and carrying power of the vessel.

Increased facilities for navigating shallow waters.

Increased stability of the ship.

Reduced size and weight of propeller.

Decrease of vibration due to the engine being balanced.

USE OF OIL FUEL ON SHIPBOARD.

Rapid progress is being made in the utilization of liquid fuel as a combustible. It is a fact that more substantial progress has been secured during the past two years in the successful installation of oil fuel appliances for marine purposes than was made during the previous century. The Navy Department is now conducting an extended series of tests to determine the value of the Texas and California product for naval purposes. The experimental plant is a very complete one, and as careful and complete tests were made with coal under the same boiler it will be possible to determine very closely the relative advantages of the two combustibles. A competitive test will be made of various burners and appliances for burning the oil, and the product of various localities will be experimented with. It is hoped not only to definitely determine the relative evaporative efficiency of coal, crude petroleum and hydrocarbon briquettes, but also the advantages and disadvantages for naval purposes of compressed air and steam as the atomizing medium for spraying the oil.

CAUSES OF NAVAL ENGINEERING TRIUMPHS OF PAST QUARTER CENTURY.

While the engineering world will rejoice at the triumphs achieved and will confidently anticipate other advances in the immediate future, the more thoughtful will give consideration to the causes which produced these results, and to the effect which such advances will have upon naval warfare and international relations.

The spirit of the times may be the primary cause of this engineering advance. The history of the world shows that human nature is restless, and that the tendency of man is to work in special directions for a century or two. There was an age of the crusades when the knight-errant reigned supreme. There was an age of discovery when nations looked for wealth and power from the acquisition of territory. There was an age of romance, literature and political revolution. The present age is distinctively an engineering one. It has been well termed the "Age of Steel," and the engineer has not failed to assume the post of honor and leadership that is his by right of training, experience and education.

One leading cause for naval engineering advance has been the perfection and increased precision of the machine tools used in machine construction. This has permitted an accurate interchangeability of the parts of the tools themselves, as well as of the appliances manufactured. The work thus turned out is uniform in structure and strength, and possesses an endurance and reliability that could not be secured in the past.

THE INFLUENCE OF THE TECHNOLOGICAL INSTITUTIONS UPON ENGINEERING ADVANCE.

In this age of engineering, the scientific and technical man will thus rise to the measure demanded, because he has been taught that efficiency, courage, loyalty and integrity are the attributes of greatness. The leading cause, however, for general engineering advance can be ascribed to the fact that the resources and capabilities of all engaged in technical work, whether they be designers, superintendents, artisans or laborers, have been more fully and thoroughly developed. And this development has been made possible by the excellent curriculum and methods of mental discipline of the scientific colleges, as well as by reason of the character of the technical press. From these sources the engineer of the present generation has secured a technical education and training which was not within the reach of his predecessor.

The standard of admission to the scientific schools is now as high as that required to matriculate in the best of the colleges of liberal arts. The trend of modern industrial development has compelled close study and deep thought to be given to the work of the colleges of mechanic arts. It is undoubtedly a fact that during the last twenty-five years more of the thought of the industrial world and more money have been expended in the building up of the scientific colleges than in the direction of enlarging the scope of the work of the classical schools. Under this powerful impulse and zeal, almost every institution of higher learning in the United States has been forced to specialize in the direction of the physical rather than in the path of the natural sciences. The older institutions have been in many cases absolutely unable to provide facilities for the many students seeking such technical instruction, and thus new colleges, devoted wholly or largely to engineering educational work, have been established. In fact, the general need is compelling nearly all colleges to increase the range and improve the character of scientific educational work. The result is that the extent and quality of the work of the engineering institutions in this country are not surpassed by the work done anywhere in Europe.

THE TECHNICAL PRESS AN IMPORTANT FACTOR IN INCREASING ENGINEERING PRESTIGE.

Only those who have studied this question can realize the influence and far-reaching importance of the scientific journals and technical publications in contributing to this engineering advance. The technical press has not only given to its readers professional information of value, but it has caused the latent mechanical talent of many inventors and engineers to assert itself. It has been only during the past quarter of a century that the engineering world began to comprehend the inestimable benefits resulting from the possession of a technical press edited along strictly high lines and maintaining high standards. The present unqualified recognition of engineering as a profession can in no small part be attributed to the persistent and splendid educational work of the technical journals.

Text books and works of reference are of great value to the designer and advanced student, but those whose duties are of an active executive nature must depend upon the technical periodicals to keep them informed as to the world's engineering progress. The technical journal therefore is, and will be, a potent force in de-

termining the importance and the position of the engineer relative to other professional men.

EFFECT OF NAVAL ENGINEERING ADVANCE AS REGARDS SEA POWER.

While the engineer may be proud to tell of his success, and may find satistaction and pleasure in analyzing the causes of this progression, the world is most interested in the effect of this engineering advance.

The substantial effect of engineering advance upon naval affairs has been summarized by President Roosevelt in his statement that the efficient naval officer of the future must be an engineer. The full import of this declaration can be appreciated by those only who go down to the sea in ships, or by those whose life and work compel them to study the influence of sea power upon international relations.

The traditions and customs of the ships of oak have given way to the commercial and technical methods that are compatible with vessels of steel. If the romance of the sea, however, departed with the passing of the moonsails and skysails from the lofty yards, the world has been recompensed by the construction of vessels whose motive power has been of such character that the duration of an ocean voyage may be determined with accuracy. The modern ship, unlike the sailing vessel of old, is now furnished with auxiliary appliances which provide comfort, convenience and luxuries that are not enjoyed even by the average individual on shore.

The effect of the work of the engineer, as regards maritime affairs, has thus been to ameliorate the condition of the seaman, as well as to provide more reliable and convenient transportation facilities. Its most important effect has been to vastly increase the value of sea power as both a shield and weapon for national safety and expansion.

THE POWER OF THE MODERN WARSHIP DEPENDENT UPON ITS ENGINEERING EFFICIENCY.

The power of the warship has increased to such an extent that the two armored cruisers and two battleships authorized by the present Congress could easily destroy within an hour, and without material injury to themselves, a fleet of naval vessels equal to that possessed by the United States a quarter of a century ago. The work of the engineer has not been confined to the designing, constructing and operating propelling engines and their auxiliaries. He has given the world the gun and its mount, the torpedo and its launching tube, armor and the various methods of attaching this protective belt to the hull, and wireless telegraphy, for it must be remembered that the duties of the ordnance and electrical expert are more of an engineering than of a nautical nature.

NAVAL STRENGTH DETERMINED BY CHARACTER AND EXTENT OF SHIP-YARDS, AS WELL AS BY COMPOSITION OF FLEETS.

The comparative strength of nations as regards sea power, as well as their relative position in dominating the affairs of the world, is directly proportionate to the output of their industrial establishments, since the relative measure of naval strength of different countries can better be determined by the number and character of the naval stations and ship-yards which they possess than by the vessels which are in the several navy lists. The engineer, whether afloat or ashore, has thus become a military as well as an industrial factor, and it will be the outcome of his work which will decide the battles of the future, whether fought on land or sea.

Another important effect of the work of the engineer in military and naval development rests in the fact that all nations have been taught that in the future the art of war will be more dependent upon the principles of engineering than of military tactics. The stategy of the future will involve a knowledge of the possibilities of mechanical appliances, for hereafter the weather gage of the enemy will not be secured by the smart seaman, but by the skilful engineer. The movement of armies on land will not be dependent upon some stroke of military genius, but rather upon the reflective work of some engineer who has mastered the subject of transporting safely and expeditiously large bodies of men and supplies.

NAVAL SUPREMACY IN THE FUTURE WILL REST IN THE HANDS OF THE ENGINEER.

In reviewing the progress secured during the last quarter of a century in naval development, the engineering profession can be saitsfied with the results achieved. It can proudly anticipate progress in the future, and can rest content in the thought that the effect of engineering work will make for the peace and comfort of humanity.

It must be remembered that the modern battleship, from keel-plate to the Marconi receiver at the mast head, is a floating machine shop and battery. There is not an hour, either day or night, when the din of hammer, the click of a ratchet or the whizz of a drill is not heard—since incessant care and attention are required to keep the auxiliary appliances in condition for emergency purposes. These auxiliaries are found everywhere—under the forecastle there is a capstan engine, while under the counter is the steering mechanism. Even within the conning tower there are so many mechanical appliances that one man must be detailed to transmit signals. The whole trend of naval development is along mechanical lines, and it can therefore be well said that in the future naval supremacy will rest in the hands of the engineer.

An Unwarranted Conclusion.

An English writer says, "At the very time when we have been assured that we are being competed out of existence we have been earning more money than ever." This is a very pertinent remark, and the queer situation which it reveals is due to the fact that figures showing the relative production of pig iron and other things by America and England are by so many taken to mean also the relative prosperity of individual concerns in the two countries. It must be evident that they mean nothing of the kind. Are the Sulzers, of Switzerland, less prominent or prosperous because they happen to be located in a small country whose statistics of manufactures in most lines look very small compared with those of America, England or Germany?—a country which produces no coal whatever, nor any iron at all? If each State composing the United States of America were a separate and independent government, England, Germany, France and smaller European countries might surpass any of these American countries in statistics of manufacture. Would that make any difference in the prosperity of American manufacturers, so long as absolute free trade were maintained between the several States as is the case now by reason of a provision for it in the Federal Constitution? Manifestly it would not, and the talk we hear so much of about England being driven to the wall simply because America surpasses her in the amount of production of certain commodities is sheer nonsense. One might as well conclude that the Hendey Machine Company is going to ruin because Torrington produces less machine tools than Hartford, or that the Niles Works must soon go out of business because since their establishment Cincinnati has surpassed Hamilton in number of machine tools produced.

The Grand Duke Boris of Russia has been visiting America (especially Newport), and when he returned to Europe was interviewed by a Paris paper, when he took occasion to praise Cornelius Vanderbilt for working upon inventions, and said that in America everybody was busy. The Parisians are particularly astonished at the Grand Duke's praise of American ways, and the *Gaulois* remarks:

"Our own young men are doing nothing in spite of themselves. With us even a lawyer or merchant, who by his own work makes 100,000 francs a year, thinks only of saving so that his son and heir may be able to swell round the clubs and do nothing. Perhaps there is a tendency among our aristocracy to engage in manufacturing industries without first, like the Baron in the old song, 'demanding pardon of his ancestors.' We have to thank Grand Duke Boris for throwing his imperial weight on this side of a debate in which snobbishness might have a part, and for finding it *chic* in a Vanderbilt to be a mechanic!"

THE POWER OF MACHINERY

BY CARROLL D. WRIGHT.

All efforts to measure mathematically the supplemented power of hand labor through invention and machinery fall very far short of accuracy. No such calculations on a general scale are conclusive, although they may be interesting and are often spectacular. We see statements now and then that the machinery of England is equal to the productive force of 100,000,000 men, and equally astonishing figures are given for the United States. It is quite easy to calculate the human power necessary to carry on the work of locomotives or of machinery where the real horse-power is known, but there are so many machines, even with the given horse-power, by means of which the manipulations formerly carried on by hand are now produced, that it is impossible to gage them on the basis of horse-power. It is often said, and generally believed, that the productive capacity of an adult skilled workman has been increased a thousandfold during the past century. It is impossible to verify such statements. Again, with these statements in mind, many men, and careful students too, come to the conclusion that machinery has displaced a vast deal of labor, and they account for the unemployed in this way. It is well, therefore, occasionally to devote a little study to the real power of machinery, not only in a general way but as shown by individual instances.

One of the best illustrations of the difficulty of arriving at a concrete conclusion is in spinning cotton. Under the old hand method, using the old-time spinning wheel, one operative could spin one thread at a time. With the modern mule spinning machine one operative, with one or two boys, can spin 2,200 threads, and the only limit to the number of threads that can be spun by the machine is in the necessity of preserving the parallel motions of the mule. Could this and a room large enough to operate the machine be secured, there is no reason why such a machine could not be made a mile long instead of the length requisite for spinning 2,200 threads. It is such instances that lead men to think that if 2,200 threads can be spun where one was spun before, there has been an enhancement of twenty-two hundred fold in human capacity.

SOME STRIKING FIGURES.

Under the old hand methods it took more than 33 hours to unload 1,000 bushels of grain; the work can be done by machinery in 5 hours. To unload 100 tons of coal required 120 hours by hand, and only 10 hours now by machinery. In quarrying marble it formerly took 400 hours, not including the time of the animals which were used, to quarry 216 cubic feet; the same amount can now be quarried in a little over 78 hours by machinery. It took 50 hours by hand to make 100,000 paper box covers, 7½x5 inches; it now requires only 9 hours and a little over to do this work by machinery. In the old way it took nearly 1,000 hours to make 100,000 paper-wrapped cigarettes, 10 in a box; by machinery it takes about 150 hours to do the same work.

In the manufacture of screws 100 of a certain size could be made by hand in 25 hours; the same product can be secured by machinery in 1¼ hours. To make 1,000 curved sewing machine needles it took 906 hours, while the same product can now be turned out in 19 hours. To harvest 20 bushels of wheat by hand a farmer had to work over 64 hours; the same product can be secured by a little less than 3 hours' work at the present time with the aid of machinery. To make 10 land-slide plows by hand took 1,180 hours; by machinery this number can be turned out in 37½ hours.

To rule 100 reams of paper, 14x17 inches, required 4,800 hours by hand labor; the actual labor time now by machinery is 2¾ hours. To make 25 sets—that is, 100—8-inch wooden wagon hubs it was necessary to expend 462 hours of hand labor; this number of hubs can now be turned out in about 40 hours. It took 200 hours of hand labor to make one elliptic spring, leather-top buggy of a certain style; the same buggy can now be made in a little over 39 hours by the use of machinery. In the manufacture of trousers it took 1,332 hours to make 12 dozen pairs of cottonade trousers with double seams; with the use of machinery the same product can be secured in 160 hours. To make 500 pounds of cord hemp, ¼ inch twisted, took 562 hours and over by hand; with the aid of machinery this quantity can now be manufactured in 3½ hours. In the above statements, hours of human labor devoted to the work is meant in each case—not the elapsed time within which the work was, or is, done.

These are only some of the individual illustrations of the supplemented power which has been given to hand labor through invention, and they could be multiplied almost indefinitely; they are, however, some of the most extreme illustrations of the power of machinery. The great instances, like the steamship, the printing press, and various other inventions on a grand scale, only accentuate the popular belief that production is going on far more rapidly than consumption.

THE FIGURES FOR THE TOTALS.

But an examination in another direction puts another aspect on the case. When examining the total products of a country at different periods one is surprised to find that, with all the power of machinery, the results as indicated by special instances are not corroborated. The State of Massachusetts in 1837 employed 117,352 hands in her manufacturing establishments, and their product was valued at $91,765,215, or $782 per capita. In 1900 there were employed in the manufacturing industries of that State 497,448 persons, and the total of their product was $1,035,198,989, or $2,081 per capita. Taking the United States at large, we can make calculations only from 1850 on. In 1850 there were employed in the manufacturing industries of the country 957,059 persons; the value of their total product was $1,019,106,616, or a per capita product for that year of $1,063. In 1900 there were employed in our manufacturing industries 5,321,087 persons, and the total value of their product was $13,040,013,638, or a per capita of $2,450.

Here is a very interesting lesson. Taking the United States at large, the per capita product of $1,063 in 1850 is com-

parable with a per capita product of $2,450 in 1900, or about 2¼ times what it was in 1850. Of course, there has been a shifting of prices. The true comparison would be in the quantity of goods produced per capita rather than the value, but it is impossible to make such comparison, because varying quantities cannot be added together to make a total. The difference in price as affecting values between 1850 and 1900 is not so great as to invalidate the comparison of per capita production; but making allowance for the changes in values one must conclude that the production of the United States in 1900 with all the wonderful machines that are used in the manufacture of goods, was not more than three times what it was in 1850. We are deceived when we make individual comparisons, and so deceived that we lose sight of general results. The above illustrations confirm this view.

MACHINERY HAS NOT DISPLACED LABOR.

The use of machinery has not displaced labor, for during the last forty years the proportion of the people that are employed in gainful occupations has constantly increased, it being 32 per cent. of the total population in 1870, while now it is over 38 per cent. Looking to those engaged in manufacturing, mechanical, and mining industries, those lines where the power of machinery has been most emphatically felt, it is found that from 1870 to 1900 the number of persons so employed increased 168 per cent., while the total population increased 96 per cent.

These facts are incontrovertible and completely upset the theory that machinery has displaced labor, when the whole population is considered. Of course, there are individual cases to which all such calculations are not applicable.

INTERESTING FIGURES BY MULHALL.

Mr. Mulhall has made some very interesting calculations relative to the productive energy of different nations. He gives the effective horse-power of steam in the United States at about 17,000,000 in 1895; this would be equivalent to the power of 102,000,000 men. He also estimates that the energy or working power of the people of the United States was 1,020 foot-tons per inhabitant in 1840 and 1,850 foot-tons in 1895, and that the collective power more than trebled between 1860 and 1895, the steam power alone having multiplied fivefold. He concluded, in discussing this question relative to the United States and other countries, that the average of energy in the United States is more than double the European average, and that 70,000,000 Americans represent as much working power as 150,000,000 Europeans. Mr. Mulhall's mathematical calculations must be exceedingly gratifying to the average American, but certainly his calculations and the instances which have been cited above all go to show the enormous power of machinery, while should the discussion be carried into sociological realms it would be found that the inventor and his complement, the manufacturer of machinery, are the greatest civilizers the world has yet seen.

Changes and Progress in the Contents and Make-up of the American Machinist.

It may be not unprofitable to note the changes that have come to the AMERICAN MACHINIST itself since the beginning. The times have changed and we have changed with them, and there has been also the change which healthy growth entails. Those who have followed our course through all the years, or who even can see one of the earlier numbers of the paper to compare with the issues of the present, will be able to note some of the differences. The subject matter with which our pages are filled has changed greatly, and largely on account of the narrowing or specializing of our work. At the beginning we dealt apparently with not only the ways and means of doing things in the shop as now, but also with what was done, or the product of the shop, and so we had much to say and show about the steam engines and other machines which the shops were building. These now seldom come in our way for mention, as our time and space are all filled with more pertinent matter. In a sense our field may appear to have narrowed, but it has really enlarged, as is shown both in the labor involved in the preparation, in the space actually occupied and in the number of interested readers. The space occupied by reading matter and illustrations has doubled, and we take pleasure in believing that the proportion of really valuable and preservable matter has increased. It certainly looks better, is in a more convenient form, and is presented in a more readable condition. Since we began, both the typesetting machine and the half-tone have come in, and they are in evidence in every number. The prosperity which has enabled the paper to become the owner of its own printing plant is shared in by every reader in the general typographical excellence of each issue.

CARROLL D. WRIGHT,
United States Commissioner of Labor, President of Clark University.

We believe that the matter presented is not unworthy of the care bestowed upon its respectability of appearance. It is well dressed because it deserves to be well dressed, and the dressing has no doubt reacted upon the material or upon those who prepare it. We have been fortunate from the first in having and holding the general good will and helpful cooperation of the men of the shop. The "Letters from Practical Men" became almost at once an attractive, and have always continued an important, feature of the paper. This department has been a nursery of technical writers who have later become leading authorities in their several trades. A great number of technical books now standard have been made up of articles previously contributed to our columns. It is not easy to realize how scarce were the writers upon shop matters before our time. The record of our pages will show how some of the best writers on foundry practice, for instance, have been provoked or stimulated to begin writing by some little thing that some other writer has said, and then have continued it because they have kept finding more to say and have found their matter welcome, not only to the immediate readers of the paper, but to the mechanical world in general. The pecuniary stimulus also has not been lacking for writers in our columns, whether their work appeared in the form of letters or otherwise. It has been the position of this paper that no one has been expected to work for it or for its readers for nothing or for merely the credit or glory of it, and it is always ready to pay for matter used, the general idea being that what is not worth paying for is not worth printing. All of the present editorial staff of the paper and their predecessors have been first of all voluntary and personally unsolicited contributors who have received pay for contributions. We are happy to be able to state that the letters from practical men were never before as numerous as during the present year, a fact which is evidenced in every issue. The volume of this matter pouring in upon us of course enforces the necessity of declining much, although we trust that the knowledge of this fact will not deter any from still sending matter in. The best and most fitting is always welcome, and there is always room for it. The proportion of original matter appearing in our pages has never been as great and we have never been more frequently quoted and our articles more numerously reproduced than now.

AN ENGLISH VIEW OF AMERICAN TOOLS

BY WILLIAM H. BOOTH.

A pioneer in the backwoods living far from other men can never become wealthy so long as he remains in solitude. He builds his own house, makes his own boots and his own roads and does little more than live from hand to mouth. It is only when other families are settled about him and there is joint sharing of expenses and division of toil in such a way that each man can confine his efforts within narrow lines along which he can work to best efficiency that our pioneer can begin to amass a surplus. Comparing the United States with Europe and at once is seen under how many disadvantages the former labors. The difference is still more marked in regard to Great Britain. Here especially there is a vast store of accumulated wealth in the shape of roads and other conveniences of civilization that are wanting in the United States. It is not that there are so many miles of railways per 1,000 of population, but that there are so many and so much of the accessories of civilization and stored surplus in a small area, accessible and usable by so many. No doubt if figures could be obtained it would be found that a very large proportion of the people of the United States are engaged in producing roads and bridges and other things that were produced for us by people long since dead. Consequently life in many respects is easier and less strenuous in old countries, and especially in Great Britain, for the Napoleonic wars gave Continental Europe a greater setback than they gave Britain. The above being true, it is obvious that the United States having much leeway, or rather headway, to make up cannot compete with Europe. This last would be true but for one thing. Continental Europe breathes of war and taxes itself to an incredible and enormous extent to maintain huge armaments, and Great Britain is also heavily taxed to maintain safeguards. But for this war taxation, from which the United States are practically free, Europe would be a haven of ease and wealth. To how great an extent all this is true may be known when the condition of British workshops is studied. Our oldest, wealthiest and best firms lately possessed workshops that had existed for years without change or improvement in tools and methods. Badly lighted, work was done under difficulties and cost enormously, and, without going into detail, it was evident that there must be some hidden source of energy which kept British trade going under the very many disadvantageous conditions that surrounded it both as to machinery, the output of the men and the undue conservatism of the employers—for I blame the employers equally with the trades unions. Both followed a narrow, mistaken policy and each reacted on the other to make matters worse. Dirty shops made dirty men, and the good man got away from the trade in disgust.

Very much has been heard of outside competition, both American and foreign. I will consider American chiefly and endeavor to trace its effect so far as regards machine tools, because it seems to me that, except in machine tools, there has been no real competition from the United States in the way of heavy engineering.

The quality of English work in the way of steam engines, etc., did not deteriorate, but the shop methods remained old fashioned simply because there seemed to be no inducement for toolmakers to improve their products and no manufacturing engineer cared to invest in new tools of better capacity when he was not allowed to use his existing tools up to their capacity. For many years now there has been a steady change going on, accompanied by much grumbling. American tools have come over in considerable numbers. The movement, so far as my own personal observation is valuable as a guide, began with small machine tools for light brass work, and the American type of tool well suited this work. American tools, as a whole, have been better designed than made. By this I mean that they have been designed for handiness rather than built very accurately or constructed for durability. There is such a thing as using a tool after it is obsolete.

HARD IRON.

Old English machine tools were certainly obsolete before they were worn out—they never did seem to wear out because they were made of such hard iron, and held even the scraping marks for years. This question of hard material is one that makes one thankful that E. R. of England and E. R. of the United States are not toolmakers, for if they were, war would be inevitable.

American tools coming over here have become heavier, and when heavier tools began to come over we began to hear complaints that they would not do the work they were sold to do and they were worn out of truth in a few months. This rapid wear was urged as a reason for scrapping, but it is certain that ordinary machine tools are not so obsolete in a year's time as to require scrapping. The obsolete theory was somewhat overdone.

I have gone carefully into this question of the hardness of cast iron, and, personally, I have no shadow of doubt that English cast iron is very much harder than anything that comes from outside. The wear that takes place in American tools manifests itself in two ways: First, it compares with the wear on our own hard irons; and, secondly, American tools made to cut American iron were too light and had surfaces too small when set to cut our hard iron. Then the attempt to run the tools at the speeds stated they would run was provocative of disaster. Failure was laid to British clumsiness on one side and to Yankee flimsiness on the other. Sober-minded men realized that the whole matter was one of materials.

DUPLEX EFFECT OF AMERICAN TOOLS.

Despite this, the sudden boom in trade and the inability of the comatose machine toolmakers here to fill orders in time gave a great impetus to the importation of American tools, which came over in thousands, especially in the cycle trade, and these tools have had a double effect. They have provided new models and new ideas which have been taken up and copied and improved, or altered, to suit British conditions, and they have brought over here many American toolmakers who have thus been enabled to study closely the conditions here and I think the interchange has been valuable to both sides. I constantly see machine tools of different

ages by the same American maker working side by side, and the later tool has unmistakably stamped on it the effect of British conditions and I see the products of English makers equally influenced by American design, and, in March last, for the first time, an American toolmaker advertises in the AMERICAN MACHINIST: "No soft materials used." When my own countrymen began to cry out that America was about to get all our trade I knew then that this was the very thing that would not happen, and similarly when I read that American cast iron was every bit as hard as our own. I was prepared soon to see what we have seen, an advertisement as above.

HARD IRON IN BRITISH FOUNDRIES.

Looking at this iron question, I conclude that the practice of both countries is at fault. I regret to think that British foundry practice is not scientific. Engineering firms who make steam engines are in large numbers. They make a steam cylinder that does actually fill the clause in the specification, "as hard as can be bored." They do this by a liberal use of white iron and hematite, and I believe occasionally cylinders have to be scrapped, being too hard to bore. The manager of the cupola arranges his furnace feeding so as to get an approximation to what he wants, casting certain other things first and casting cylinders when the white iron is coming down. This is working by experience, and the results may be creditable to the man and still be uncertain, and certainly most other things than cylinders are too hard, and things that have no wear on them, such as a bracket to carry a bush, are harder than the hardest American castings. Now it appears to me that American foundry practice is as bad as ours, but in the contrary direction. The aim is to make some things soft, and the result is everything soft. Here we can compare our own methods with the methods of outsiders. It is doubtful if this has been possible to any great extent in America for some years, owing to prohibitory tariffs, and to the fact that when cast iron did leave here for America it was usually the softer Scotch irons, so that the benefits of comparisons have been lost.

British workshops have taken up with new methods—not too quickly, it may be perhaps too slowly—but it has been largely due to American influences. But British engineers have found that they cannot, in many ways, go to the full length of American practice, nor is it well they should do so.

AUTOMATIC MACHINES AND BOLTS.

Let us take, for example, the automatic and turret machinery for bolts and large pins. It is looked on here as a mistake to cut such things out of the solid bar. The attempt has been made and has failed, and important pieces are forged. The inside of a bar of mild "automatic" steel has been described to me as rotten, and it is the inside that is left when a bolt of any large size is turned out of the solid bar. The head of a forged bolt does not drop off without apparently sufficient cause.

THE PROSPECTS.

In a general view of the whole question it certainly appears that very considerable influence has been brought to bear on British workshop practice also as a result of American machine-tool competition; our own machine-tool men have profited by it and there are some who say the American invasion has run out, as far as concerns machine tools. Personally, I do not think so, because I have been able to trace the effect of our conditions upon American methods. Certain American machine tools will undoubtedly retire from view, but others will remain with us, for they keep changing in the direction of meeting the requirements here, and this is

WILLIAM H. BOOTH,
Engineer.

evidence of an intention to continue and an ability to see conditions and meet them. Large numbers of old shops have been dismantled here and others have been wholly removed to fresh sites. Thus one shop, the oldest in the world of its kind, simply moved 30 miles from a back street into open country and started like a new concern, but with three-quarters of a century of good will behind it and an historical name. In a few years, at the present rate, there will be no really old workshops left, and the machine-tool business will be brisk here for some time to come, for those who can compete in price and will meet conditions. It is unlikely that with all the change here there will be any giving up of the idea of making things durable and, call it so if you will, clumsy. There is an American firm doing business here that advertises its machines as doubly as heavy as they were a few years ago, and this additional weight is one of the interactions I have observed in many things, and English manufacturing engineers are finding that they need not worry about competition with outside goods of equal weight and finish.

OPINION OF AN EMINENT ENGINEER.

An eminent toolmaker recently gave me his views on many points. First, as to American machine tools generally, he considered them good and thought with me that they had exercised a good influence on tool design, and he stated that during the last few years there had been a great awakening among English makers, and first-class tools were now being produced by firms who, a few years ago, were making very poor tools of the kind that carried no name plates. On the much debated question of flat or V beds he agreed that the subject was not worth discussion. Each type had advantages and disadvantages, and, after all, a machine tool was a compromise all round. He ridiculed the old American claim that American designs provided better distribution of material, as though a machine tool were to be designed like a bridge to carry safely so much stress. The tool required to be stiff, and if designed as *stiff* everywhere as it ought to be, it would be *strong* enough everywhere, though obviously not equally strong. This, however, matters nothing, for the vital feature of a machine tool is stiffness, and in this respect American tools, once so lacking, had come along very fast of late.

INTERCHANGE OF ADVANTAGES.

In the foregoing I have endeavored briefly to show how the import of American tools has been for the advantage of Great Britain, and how it has also been a source of improvement of American tools. Both sides have seen something of the difficulties of the other side, but the advantage on the whole has, I think, remained with us.

An excellent American tool was shown me lately of which three details in particular repeatedly failed that did well in America. It was all a question of materials to be cut and rates of cutting. The maker of the machine, however, has been here and done good business and he has altered the above three details as well as others and fitted the tool for the conditions which obtain here. As the tool now stands, it is a combination of high excellence and weight.

THE FUTURE. NEW STEELS.

As regards the future, there will always be a sale for the better class of American tools at fair prices. There is no prejudice to overcome except on the question of hardness, but this is less noticeable with newer tools because wearing surfaces are more liberal, and probably some attention is being given to prevent excessive softness.

Perhaps the point requiring particular

attention by all toolmakers is that of tool steel. In the first place, it seems to me that ordinary steel has not, in the past, been worked to its maximum capacity. The new steels have come along and have been worked at once to their maximum capacity. This maximum capacity has often been the maximum capacity, not of the steel, but of the machine tool or its belt. There can be little doubt that the new steels have come to stay and that they will effect a great change in belt pulleys and speeds. They will in fact gradually change machine tools and shop practice, and those who realize this and first act on it will first reap the result.

A certain class of men, whose ignorance of economic facts is so astonishing that they loudly bewail the ruin of this country because they have suddenly discovered that the forty million people of these islands produce less than the United States and Continental Europe combined, would have us believe that we are lost beyond hope. Something of this seems to have been accepted by ill-informed people both at home and abroad. I need hardly say that nothing more erroneous could be conceived. Old-fashioned tools, worn-out shops and restriction of output are but passing features, just as I believe the small faults in American tools are rapidly curing themselves.

I am led to believe that American machine workers are generally better and more skillful than our own. I also believe that British skilled workmen are on the whole better craftsmen than Americans. I am led to this conclusion from the wonder expressed by Americans who come here that good work can possibly be produced in such and such a shop they have been in. My own experience is that work better and sounder than will be found in any other country is turned out of many such shops. I do not, from this, argue that such shops should be left as they are. No doubt their work is costing too much and it might be done as well at less cost. But all this merely shows that there is a big margin for economy, and, where this is so, such places have not yet experienced any very great pinch of competition.

In what I have written above I should like to say that I have tried to convey a general impression of what I have observed and heard from others as the results of their experience. I have had the advantage of seeing many workshops in all parts of the country engaged in every variety of engineering manufacture, and I think it may fairly be stated that Great Britain has profited in many ways from the liberal introduction of American tools and that the American tools have been improved on their part. I would say there are some British workshops than which nothing could be worse, yet I have seen the products of the worst shop I know working in an American shop and giving good satisfaction. These worst shops, it seems to me, are those which are always pictured by our pessimistic journalists, who, when abroad, see only such shops as Löewe's or Brown & Sharpe.

PECULIARITY OF THE MACHINE-TOOL BUSINESS.

The machine-tool trade in general seems to me to be the seat of more ill-natured criticism and more loose statement and wild promises and denunciations of your neighbor's goods than any other business. Trivial differences of design are magnified and discussed as though vital, and there is a lack of broad-minded appreciation of the differences of environment and conditions which is positively distressing.

Some few years ago no machine-tool maker ventured to offer advice to a manufacturing engineer as to the tools he might buy or the methods he should follow. He would have been told to mind his own business. To-day a good deal of help and advice is often requested and the toolmaker and user, as they should be, are often in consultation as to tools, methods and organization. Machine-tool making in America has been, I take it, considered a reputable business for some years, whereas here for a time it certainly was but little considered. The change for the better in this respect has very largely arisen as a result of American competition in the business, but there is still room for good sound business men who will conduct their business with strict integrity.

London.

Localized Industries.

The statistician of the Census Bureau gives the following interesting particulars from the census of 1900:

"Measured by the value of products, more than 85 per cent. of the collar and cuff manufacture is carried on in Troy, N. Y.; more than 64 per cent. of the oyster-canning industry in Baltimore, Md.; more than 54 per cent. of the manufacture of gloves in the adjoining cities of Gloversville and Johnstown, N. Y.; more than 48 per cent. of the coke manufacture in the Connellsville district, Pennsylvania; more than 47 per cent. of the manufacture of brassware in Waterbury, Conn.; more than 45 per cent. of the manufacture of carpets in Philadelphia, Pa.; more than 45 per cent. of the manufacture of jewelry in Providence, R. I., and the adjoining towns of Attleboro and North Attleboro, Mass.; more than 36 per cent. of the silverware manufacture in Providence, R. I.; more than 35 per cent. of the slaughtering and meat packing industry in Chicago, Ill.; more than 32 per cent. of the manufacture of plated and britannia ware in Meriden, Conn.; more than 24 per cent. of the agricultural-implement industry in Chicago, Ill., and more than 24 per cent. of the silk industry in Paterson, N. J.

"The number of wage-earners engaged in slaughtering and meat packing in South Omaha, Neb., constituted 89.9 per cent. of the total number employed in all industries in the city during that year. The specialization of McKeesport, Pa., in the iron and steel industry was 88.8 per cent.; of East Liverpool, Ohio, in the pottery industry, 87.4 per cent.; of Bethel, Conn., in the fur hat industry, 86 per cent.; of Tarentum, Pa., in the glass industry, 81.1 per cent.; of Fall River, Mass., in the cotton goods industry, 80.4 per cent.; of Brockton, Mass., in the boot and shoe industry, 77.4 per cent.; of West Hoboken, N. J., in the silk manufacture, 76.2 per cent.; of Gloversville, N. Y., in the glove manufacture, 74.9 per cent.; of North Attleboro, Mass., in the jewelry manufacture, 71.7 per cent., and of Troy, N. Y., in the collar and cuff industry, 68.7 per cent."

When I Hear the Whistle Blow.

What's that you say, young feller—you wouldn't give a rap,
If you wus me, fer all the shops that ever done a tap?
You say you'd like ter git a chance ter leave the shop behind,
An' that you're sick an' tired of the everlastin' grind.
My lad I felt like that myself, when I was young like you,
But things have changed some since those days, an' Uncle Dan's changed, too.
Though it worries me no longer whether pay days come or go,
Still I feel my old blood tingle when I hear the whistle blow.

Yes, I know I'm safe on "Easy street," an' needn't work no more,
But jest the same I like ter hang around the old shop door.
I like ter see the wheels go round an' hear the buzz an' hum
Of lathe, an' planer, drill an' mill—it makes my old blood run;
I like ter see the bright sparks fly, when a feller grinds a tool,
An' when I see him start a cut I feel jest like a fool.
I feel like startin' then and there, ter take a hand myself,
An' let them know as Uncle Dan ain't laid up on the shelf.

For thirty years the toot of 'hat old horn up near the stack
Has sent me home contented evenings and in mornings brought me back.
Its voice is old an' rusty now, from a tootin' all these years;
But just the same its signals come like music ter my ears.
That's why yer see me hangin' around the old shop door;
That's why I leave my pipe an' paper layin' on the floor,
Fer no matter what I'm doin' I jest feel I gotter go,
Fer ter git a hustle on me when I hear the whistle blow. WOODWORTH.

TWENTY-FIVE YEARS' PROGRESS IN MACHINE SHOP PRACTICE

While we all more or less appreciate the great ess of the changes that have been brought about in recent years in American machine-shop practice, and the vast difference in precision and efficiency between the ways of a quarter of a century ago and those of to-day, it is not so easy to specify with any minuteness and completeness of detail wherein the differences consist, and it is still more difficult to enumerate the agencies and processes by which the results have been produced. The changes are not by any means all due, nor perhaps chiefly due, to the new inventions and devices that have been originated and which have become operative within the period under consideration. Some that have proved most effective had been in existence and had found limited employment for a long time previously, and some of more recent development were waiting to be appropriated and employed, and from the appropriation and employment of these facilities ready to hand at the beginning of the last quarter of a century the great progress in efficiency has largely resulted. This is in no way meant to ignore or belittle the aids to progress that have been found in the devices and practices that may be conceded to have actually originated and begun their helpful career since the AMERICAN MACHINIST began its course, and which it has largely helped to make known to the trade and to stimulate the production of.

Progress has not come by chance, but as the result of intelligent and persistent endeavor. Shop conditions have been studied and shop operations have been systematized with most advantageous results. They are quite generally conducted in a more businesslike way than formerly. The old hand-to-mouth, haphazard, unplanned way of running a shop has been abandoned, and now everything is arranged for and looked after with system and with constantly assigned responsibility. Annoying interferences and unnecessary delays in the sequences of shop operations are planned to be avoided, and everything necessary to be done is arranged to be done at the best time, in the right way, with proper facilities and only by the right man; or at least these are becoming the dominant ideas in shop management.

SUBDIVISION OF WORK.

In a large and general way probably the most pronounced and pervading principle of progress has been in the dividing up of the work, the narrowing of the individual routine, the apportioning to each of that which he has been best equipped to do. This has applied throughout the entire range of industrial employment from the highest to the lowest. The one man in the primitive shop knew everything that was done or to be done, knew how to do it and actually did it. In few shops of to-day is there any man who fully fills either of these functions. So far as thinking and planning was done in the olden time, it was done while the hands were working. Now we divide the thinking and planning and providing entirely from the manipulation of the material, and both are better done. The further departure from the primitive ways which has been most pronounced in these recent years has provided for much more head work as compared with the hand work of the trade. The accountant and the provider and distributer, however designated, have all risen to greater importance, and especially has been developed the function of fully planning all the work before its execution.

THE DRAFTSMAN AND THE BLUEPRINT.

The draftsman was never so important and never so numerously and profitably employed as now. The advanced position of the drawing room and the draftsman perhaps tells the tale of progress as suggestively as any other one thing. A shop of any size and standing to-day without its drawing office and its corps of draftsmen would be an anomaly, while a quarter of a century ago a solitary draftsman to a shop was the exception rather than the rule, and even he was often scantily employed. There has been remarkably little change in the methods and facilities of the draftsman except in one particular, but that has been one of enormous help and influence. The blueprint was one of those things which, a quarter of a century ago, was ready to the hand of the machinist and engineer, but which as yet had not found employment. Its now universal use is a curious corroboration of the general principle that inventions which facilitate the doing of work and which multiply results increase rather than decrease the amount of work to be done right in the line in which they are employed. As far as we can see, nothing in these years has more tended to increase the amount of work for the draftsman than the cheap and ready means of reproducing his work. Of the changes in shop methods which have been brought about by the blueprint, it is scarcely necessary to speak. The rule now is to have a correct and detailed drawing for every piece of work and to have the work precisely to correspond to the drawing. There is no permission to the workman to use his judgment, which may be right or may be wrong; there is no hesitating or wasting of time over uncertainties and no possibility of costly errors if the blueprint is adhered to.

THE TOOLROOM.

The toolroom may now be recognized as an established feature of every organized shop, but a quarter of a century ago it had been established only in comparatively a few of the more advanced and enterprising. The progress of these years is more marked, however, in the extension of the field and scope of the toolroom than in its initial establishment. It at first assumed to store in a place where they could readily be found the tools which were used by the men in common. It came quite naturally and almost immediately to have to look after the condition of those tools, and to repair, sharpen and adjust them, so that when handed out they would always be ready for immediate and most effective use. The advantages ensuing from this led to the suggestion and adoption of a still wider range of employment. The twist drill grinder of course was recognized at once as specially belonging to the toolroom, and the tool grinder, when it made its appearance, not only found ready admission for itself, but for the numerous tools for the various machines. Milling cutters, reamers and other tools requiring cutting edges of constant sharpness and accuracy at once called for the universal cutter and reamer grinder. The repairing and sharpening and general maintenance of the tools led naturally to the entire making of many of them, and then the providing of jigs and templets led to still further enlargement of function and equipment, until the toolroom has become a miniature machine shop with usually an equipment of a full line of machine tools, and with special exactions as to their precision of action. It needs not to be said that

the efficiency of the general shop has been largely enhanced by the extended reach of the toolroom.

THE STOCKROOM.

Closely allied to the toolroom is now the stockroom, and indeed it is not so easy to draw a perfectly dividing line between them. Many of the tools of the shop, especially those most numerously and generally used, are produced in factories specially fitted for their manufacture, rather than made in each shop for itself. Drills, taps, dies, reamers, milling cutters and similar tools are kept in stock by the toolroom, but set-screws, cap-screws, studs, nuts, keys, steady-pins and many special pieces, such as handles, collars, bushings, it is found vastly profitable to have manufactured to order, and these are of course carried by the stockroom. It is found that these articles require constant watching to maintain sufficient accuracy. The articles carried in stock must fit the places produced by the tools. Screws, for instance, and studs must fit the holes made by the taps, and so on, and this involves co-operation between toolroom and stockroom, for it is sometimes the tool, whether home made or factory made, and sometimes the screw or other piece in the stockroom that is off size or inaccurate in some particular, so that it will not do for the toolroom and the stockroom to be unacquainted with each other.

The factory system of tools and supplies for machine work enables the individual shop to turn out an amount of work *per capita* vastly greater than a quarter of a century ago. Even when allowance is made for the labor of the factories in producing the stock articles, adding this to the labor of the shops which use the supplies, it is still found that enormous economies result from the modern system.

MATERIALS.

There has been quite a change, and apparently all for the better, in the materials with which the machinist has to do—a change which is still progressing. This change applies to both the material worked upon and to that of the tools and machines of the shop themselves. The first aim has been to provide material best adapted to the purposes it is to serve in the completed machine or structure, but incidentally ease and facility in the shop operations upon the material have been promoted. Wrought iron has experienced the fewest changes of any of the materials as to the condition in which it comes to the shop for manipulation, but from being the most important of the materials worked upon it has dropped away now into comparative unimportance, so that we need give it little attention.

The status of cast iron has apparently little declined, but its position is still quite different from what it once was. Of old, cast iron was simply cast iron. In the shop there were usually known only cast iron and hard cast iron, the latter being merely the designation for iron which it was found difficult or impossible to cut. Hard castings, once too familiar, now rarely come to annoy the shopman except when they are imperatively required for some special purpose. But there has been a differentiation and classification of cast iron to adapt it to different uses, and for whichever purpose it is destined the iron of that class is usually found so reliably and constantly alike that cutting tools and speeds of cutting may be adjusted to the work in hand with comparative certainty as to the results and as to the time employed. Sound castings also are much more generally the rule than once they were, and the losses of time through blow-holes, sand patches, cores out of place and the like are greatly diminished.

Steel in the olden time was used almost entirely for cutting tools, or more rarely for working purposes where extreme hardness was essential. The tool steel we now have is of course the best we have ever had, but the best we had in the olden time was very respectable material. We have gained very much in the ability to produce reliable steel for cutting tools, and steel which, if of the same make or brand, may be relied on to constantly have the same characteristics, and we have learned much of the best ways of manipulating and tempering steel for our several purposes, so that in the combination of better steel and better knowledge and skill in treating it we show better results than ever.

The mild steel, which is the supreme material of the shops to-day, may be considered a thing new to the trade, and whose use has developed almost entirely within the last quarter of a century. It is a material which has the widest range of application and with a perfect facility of adaptation to every special use to which it may be applied. It is a delight to the mechanic to cut and work it. Its homogeneity and flawless solidity are a marvel which could be appreciated only by the workers of long ago, who knew only cast iron and wrought iron to work on. The almost absolute constancy of texture and density of this material has made the study of its manipulation a thing of great exactness, and the rate at which the cutting of it can be accomplished has almost lost every element of uncertainty, so that the workers in it are provided with standards as to rates of production which it is idle to kick against. The day of steel castings may be said to be only dawning as yet, but it surely promises a wide extension of the uses of steel and of economic gains accompanying it.

SMALL TOOLS, SCALES, MICROMETERS.

We must not forget in our enumeration the small tools of the shop and the makers of them who have kept offering them to the worker with constant additions of refinement and accuracy. The making of these tools is a new line of manufacture whose development has accompanied the growth of our shop practice. It is a curious instance of cause and effect working together and retroacting to stimulate each other. Even the meaning of the word tool has had to be extended. Some of the most important tools of the shop now do no actual work. They make no chips and have no actual part in the shaping of any piece. These tools all, or nearly all, have to do with the gaging or measuring of work. There was a time, not so far back, when all the tools of this class which the machinist used, except the two-foot rule, were made by the individual workman. Calipers, squares, straight-edges and gages of various kinds were home-made and hand-made simply because they could not be bought. The making of these tools, and more particularly scales and micrometers, with the accuracy and refinement that have been imparted to them, has been a most powerful stimulant and aid. All the trade has, through the use of them, acquired a habit of precision before undreamed of. With the ability to gage and measure, and also to cut and shape, the metals with minute accuracy has come the demand from the planners and supervisors of our work for constantly higher standards of production. We are now able, thanks to the facilities provided for measuring and to our developed habit of accurate measuring, to produce successive pieces practically alike. As things which are precisely alike must fit or match in any place where any one of them will fit, out of this has come our entire system of so-called interchangeability in manufacture, and the time once wasted in trimming and fitting each individual piece is eliminated.

THE TWIST DRILL.

The twist drill was already at work and had given most encouraging examples of what it could do when the AMERICAN MACHINIST was born, but it was far enough from having attained to proper appreciation and full employment. Twist drill practice as we now know it may be said to have only just begun to be developed. The drill was in a way waiting for some of its necessary accompaniments. Drill chucks had to be numerously invented and sifted out and improved. The twist drill grinder also had to make its way. At first the old machinist undertook to grind his twist drills by hand as he had been grinding for centuries the old flat drill, but this was not giving the new drill a fair chance, and when the twist drill grinders began to appear they soon demonstrated their necessity in the enhanced efficiency and prolonged life of the individual drill. It is a rather significant thing that the first power-driven tool shown in the AMERICAN MACHINIST was a twist drill grinder. The machine then shown would probably not hold shop room anywhere to-day, as it was without any of the features that later were developed in this line of tools. It simply assured

the grinding of the two lips alike without any clearance, which had to be afterwards done by hand. There was also required for it a separate bushing for each size of drill ground. Of the later drill grinders which appeared and which have been so frequently illustrated in these columns, it would be invidious to speak, but they soon completely solved the drill-grinding problem, and the numbers in which they have been and are still sold sufficiently attest their value to the trade. The drill was only completely satisfactory when the drill chuck and the grinder were also satisfactory as its adjuncts, and only as these latter have found place has the drill itself been fully and properly employed. As the drill demanded the drill chuck and the grinder, so it developed the jig, and only with the modern twist drill would the modern jig be possible. The drill therefore can never be considered by itself alone in computing its value in modern shop practice. The drill chuck and the grinder, the jig and the accurate drill press, all co-operate and are interdependent.

THE TOOL GRINDER.

The tool grinder was shown on the first page of the AMERICAN MACHINIST at once upon its practical completion and when first offered to the trade. Its publication was in the issue of August 13, 1887, fifteen years ago, and the date may be considered a memorable one to the trade, as the machine and the change of practice which it inaugurated were both most epochal and revolutionary. We all know, but it is still difficult to realize, how loose had been the practice as to the shapes of cutting tools, the most important detail of practice, it would seem, where the making of chips was the principal business. For every tool there is of course a best shape. This best shape was practically never attained, and certainly never maintained under the old "system" of individual and irresponsible grinding. It was the universal custom for every man to grind and regrind every cutting tool he used as long as it lasted, according to his own idea of what was best. The idea of the man may have been far from correct at the first grinding of the tool as it came from the blacksmith, and if his idea, such as it was, was carried out in this first grinding, the idea was gradually compromised upon the successive regrindings. The old tools upon any latheman's board, for instance, almost invariably showed different and always more disadvantageous shapes as compared with his own new tools.

As a mechanical invention the tool grinder was a daring one. The difficulty of accomplishing what it was proposed for it to do must have seemed insurmountable to any ordinary machine designer, and the ultimate production of a tool grinder that could perform so intricate and exacting a task so satisfactorily was an inventive feat whose magnitude can scarcely be exaggerated.

The advent of the machine was a gift to the trade of great possibilities of increased facility in the cutting of metals. It enabled the systematic investigators of the details of machine shop practice to experimentally determine the best shapes for the cutting tools of the different machines and for the different operations of the different machines, and these shapes being determined, the grinder would unerringly reproduce them. It added to the effective working time of the individual workman all, or nearly all, that he had previously given to the grinding and regrinding of his tools, and, what is of greater importance, it insisted upon his constantly using the most effective shape for his cutting tool. It also promoted the habit of using the tools with sharper edges by always providing reground tools ready to the hand.

IMPROVEMENTS OF STANDARD MACHINE TOOLS.

It is not at all necessary, and we will not here attempt, to speak in detail of the improvements that have been made in a quarter of a century in the established tools of the shop—lathes, planers, drills, shapers and the others. These tools have been running constantly in all the shops, and from time to time one and another has suggested this thing and that, and these as they have been approved by successful practice have found embodiment in the designs of the builders. The sole ultimate function of these machines is the cutting of metal, the making of chips, and the machine has been studied in its relation to its cutting tool. They generally have been made stiffer and stronger, with larger and better disposed wearing surfaces and with greater attention to the materials employed and to the hardness or other effective condition of the material. The drives have almost universally been made stronger; there has been a careful study of feeds and speeds, and gearing and other driving mechanisms have been provided for securing as nearly as possible the best cutting conditions. Besides making the machine tools stiffer and stronger and of wider range of adaptability, they have been made distinctly handier for the workman. The movements of adjustment which require frequent manipulation have been made as accessible and as easy of operation as possible. The standard of workmanship upon the machines, or of the results which good workmanship is assumed to secure, has distinctly advanced, so that the machines by their normal movements guarantee greater precision of result. Many apparently trivial details of improvement have combined with those more evident and more important, so that as a whole the difference between the machine tools produced today and those produced twenty-five years ago speaks for itself whenever types of both periods can be fairly compared.

THE MILLING MACHINE.

Perhaps no other of the fully established machines of the shop has found increased and diversified and, it needs not to be said, profitable employment to the same extent as has the milling machine. It has usurped to itself the entire machining of vast quantities of work for which only the planer, the shaper, slotter or some other old tool would once have been employed. It has been developed in various shapes and combinations and is made in large sizes and for the heaviest classes of cutting. It is not content even with this, but attacks with advantage in portable designs plane and other surfaces on the largest pieces that require to be machined. The cutters used in the milling machine have been developed simultaneously with the machine itself, and have become astonishingly efficient and lasting, and the work produced is capable of the most minute accuracy as to size, intricacy of shape and perfection of surface. From standing in the old shop, too often solitary specimens of their class, in many shops they now outnumber any other machine tool.

THE TURRET LATHE.

In no machine tool probably has there been in twenty-five years such a constant growth and, in the total, such a marvelous development as in the turret lathe and the screw machine, and no other tool has led the way to such radical changes and to such increased productivity in machine-shop practice. It may be said to be of all others the great labor-saving tool of the shop. The turret principle was not new a quarter of a century ago, but all the possibilities of its application had yet to grow out of it. In an early issue of this paper was shown a machine for bolt cutting with a set of dies for the different sizes of bolts ranged around it. A crude turret lathe appeared in the advertising page of the second or third issue. The form of the turret, the best manner of holding its tools, and also most of the tools themselves, its stops and gages, the changes of speeds and feeds and the reversals of rotation, with the various movements of transverse or auxiliary tools in combination were added until the machine became in itself one of the mechanical wonders of the day. The automatic features began to appear in their completeness only when the AMERICAN MACHINIST was a dozen years old. This complete automatism has made the screw machine a tool of the factory rather than of the shop, and the very term "screw machine" has become, if not a misnomer, at least a very inadequate designation, as the machine is now more frequently employed in the production of numerously duplicated small (and some not so small) pieces other than screws. The material which fills the stockroom of the up-to-date shop is largely the product of the screw machine. The turret lathe, however, has not abandoned the shop, but is found there in other forms and doing effective work where only a

few pieces of a kind are produced at a time. To many mechanics the ponderous turret lathe is one of the most grotesque tools of the shop, but the work that it turns out is not often laughed at for either its quality or its quantity. The flat turret lathe, too, has been constantly improved and persistently pushed by one who has thoroughly believed in it until the trade also believes in it and employs it. There are other turret lathes too numerous to mention in constant use in practically all the shops, and no tool is now more indispensable for cheap and rapid production.

THE GRINDING MACHINE.

The grinding machine is the newest of the now established tools of the machine shop, and its use involves the most radical departure from the old practices. The beginning of the grinding machine as now employed did not long precede the establishment of the AMERICAN MACHINIST and its growth and development, and especially the establishment of the general practice of finishing machine parts by machine grinding is nearly coincident with the life of the paper. The gain to the machinist by the use of the grinding machine is twofold. The surface produced is vastly superior for nearly every purpose to the surfaces produced by the cutting tool of the machine or by the hand of the filer. The minute accuracy of dimension and precision of shape secured in the final process is something that would have been impossible and which was never attempted by the older methods. A third result in most cases is also the reduction of the total cost of production. The man operating the lathe, planer, shaper, miller or other tool, who does the machining of the piece preliminary to the grinding, is relieved to a certain extent of responsibility, and he can give his attention and devote his energies more to the rapidity and less to the finish of his work. The finishing cut otherwise imperative is usually made superfluous by the subsequent grinding process. The minute measuring or gaging which comes at the last is done by one man instead of by several men, so that his constant exercise of extra care makes him expert and reliable. The grinding machine in many lines of work may supersede the cutting tool entirely, in which case the economy of it is self-evident.

COMBINATION TOOLS FOR HEAVY WORK AND ASSEMBLING.

Some of the changes in machine shop practice in recent years have been the outgrowth of necessity rather than the result of the planning of economical methods, but economy of time or labor has generally resulted. The necessity which has led to changes of this character has chiefly resulted from the increase in the sizes of engines, dynamos and other machines produced in the shop, and in the weight and dimensions of the constituent parts. The marine engine and the railway power-house especially keep calling for larger and heavier work. This has quite generally led to a change in the mode of machining the pieces, so that where it was the old practice to move the piece past the fixed cutting tool on the planer, the big lathe or the boring mill, the similar but larger piece is now held stationary and the tool is made to traverse it. The tools resulting for this purpose, while still formidable, are generally lighter and more easily and quickly handled for any specified job of machining. These adaptable tools, often of a combination character, doing equally well drilling, boring and milling if nothing more, are usually stationary in the shop, but tools of the same character are often also portable and are used not only around the shop but also are sent out and do good service in the work of erecting the big engines and machines of the day. In the erection of the large engines of the modern power-house it is quite general practice to do in the act of erection some of the work which it would once have been necessary to do in the shop, and to do this work the special tools are provided and the power to drive them. Thus the flywheel, when finally put together on its shaft in place, requires a number of large rivets through the rim, and the holes for these are bored and reamed by a machine movable alongside, and a hydraulic press is also at hand to force in the pins and rivet them over, and then the surplus is also machined off in place. Other operations of this general character are also provided for to be done once for all at the last with a considerable saving of labor in handling and of time in waiting in the shop for the succession of operations.

TOOTHED-GEAR PRACTICE.

From the strictly mechanical standpoint one of the most striking departures within the last twenty-five years has been in the making of toothed gears, or, more specifically, in the perfect shaping of the gear teeth. The perfection in the production of gears and their satisfactory working has retroacted upon the designers of machinery and has led to the more general employment of gearing in machine construction with most satisfactory results. The making of bevel gears had always been a problem for the mechanic, no means having been devised for more than approximately shaping them by machine cutting, leaving them to be finished by hand filing. The Corliss bevel gear cutter exhibited at the Philadelphia Centennial Exhibition, in 1876, may have been the provocative to Hugo Bilgram to produce his bevel gear cutter. This machine was illustrated in these columns in 1885, but it had been in successful use for a considerable time before that. It makes a practically perfect bevel gear tooth entirely by machine action, or in fact it so solves the problem of bevel gear production that bevel gears are produced as satisfactory and running as smoothly as spur gears. An important function of this machine has been in the production of correct patterns for cast gears, and in this way it has exerted a powerful influence for improvement in gear practice and has advanced the general standard of ideas as to what should be acceptable in gearing. The Fellows gear shaper, which appeared in 1897, was another decidedly original departure in gear cutting curiously related to and properly following the Bilgram bevel gear cutter. It is properly a new system of gear generating, as the cutter itself is a machine product. The results of this device have proved as satisfactory in their line as did those of the Bilgram machine, and have been helpful to the advance in general gear practice. Others have made special studies of worm gearing and helical gearing in general, showing its economy of operation when correctly constructed and providing the ways and means for such construction. Worm gearing has been employed in elevator service, in machine drives and elsewhere, thereby in most instances greatly implifying the design, reducing the cost of construction and saving power in operation.

PNEUMATIC TOOLS.

Among the shop appliances which may be said to be almost entirely new within the life period of the AMERICAN MACHINIST is the entire line of pneumatic tools. There is of course not the slightest novelty in the compressing of air or in the use of the power developed in its re-expansion, but the tools which make the application of the power to shop purposes are practically all new, and the habit of using them is of still later date and is in the full swing of development at the present time. Perhaps the most general shop use of compressed air is for direct hoisting over individual machine tools. The hoist suspended from a jib crane or with a trolley traversing a line of overhead rail and transferring heavy pieces of work from one machine to another or to or from floor or bench as required, is now a familiar and highly appreciated feature in every leading shop. It is a great convenience also on the erecting floor and elsewhere. The pneumatic drive is also frequently used for portable tools, but this special field belongs now rather to the electric motor. It is no small convenience to have a jet of air at hand merely for blowing away the dust from the work when required, and we find it now frequently so used. The air jet is a frequent adjunct of the upright drill and other machines where cast iron dust abounds and where it is often imperative to remove it. The pneumatic hammer, the chipper, the riveter and the portable pneumatic drill are tools which have done much to quicken the doing of work for which hand labor has heretofore been the sole reliance. The pneumatic tool is perhaps of more value outside of the shop than in, or for the erection of work more than for the preliminary construction, but wherever used

its usefulness and value are attested by the rapid extension of its employment.

ELECTRICITY.

It is scarcely necessary to speak of the advent of electricity in the modern shop, as it has such a way of speaking for itself. It is nothing if not self-assertive. It has electrified the trade. It has quickened and facilitated innumerable shop operations and holds itself ready to do almost anything that is to be done. It gives the machinist a better light to work by than he has ever had before, and it is the ideal means of driving his machines. It animates the traveling crane and renders the line shaft superfluous. It drives any machine of the shop as it was never driven before, and the machine may be placed in absolutely any position which other circumstances may make most convenient. It ignores rectangular lines, and whatever it is asked to drive requires no lining up, no leveling or plumbing, no measuring of distances from anything else. It is not embarrassed in the least by the size of any job, from the largest to the smallest. It will drive the biggest machine or the entire shop of any size, or it may be embodied in the design of a machine for any minute details of movement that would otherwise require intricate trains of mechanism.

PRESS WORK.

In the last few years the use of the power-driven or hydraulic press has rapidly increased. The press and its work are unique in one respect, as it is the only machine and its operation involves the only process in which, after the material is once cut from the sheet or bar, there is no making of chips. The press, as such, does neither cutting nor abrading. It is usually a more or less costly machine and the preparation of dies for it is often among the most costly work of the trade, but when in successful operation the saving of labor in its product is enormous. Articles quits elaborate are often numerously produced by press work which could not be made by the usual cutting processes for one hundred or even one thousand times the cost. The press, by reason of its rapidity of production and the manifolding of its product, belongs to the factory rather than to the machine shop; but even when in the factory it is so often employed in producing parts which are ultimately used in the shop that it has to be reckoned with as a quickener and cheapener of shop production.

SPECIAL AUTOMATIC TOOLS.

Besides the constant improving of all the standard tools of the shop there has been going on at the same time the designing of special tools for specific operations requiring frequent repetition in the individual shops. Many of these tool never come to the knowledge of the general mechanical public. It is quite frequently found possible and practicable to prepare a machine with entirely automatic devices for the doing of some operation which has before demanded skilled labor. The automatic tool, where it finds employment, has the double advantage of fixing the time for a given job and also of enabling it to be looked after by a cheaper man, or, if he attends to two or more, by a fraction of a man. Some of these tools operate in the end to drive a job out of the shop and make a factory job of it. One thing after another which it has been the machinist's job to make he now gets as "supplies," and all as the result ultimately of his own pushing ingenuity. We need only specify in this connection the interesting line of special automatic machinery employed in the manufacture of brass valves.

LUBRICATING AND ANTI-FRICTION DEVICES.

In the progress of the last twenty-five years we have attained to a more adequate appreciation of the function of the lubricant and increased attention has been given to the lubrication of the working parts of machines, both the machines built in the shop and the machine tools of the shop, and in the same line has been the development and application of anti-friction devices, such as roller bearings and ball bearings, which ignore lubrication or render it superfluous. It is now recognized, as it has not always been, that the lubricant, where the roller principle is not employed, is really a part, and a most essential part, of any running machine, and the lubricant which was formerly applied sparingly or intermittently is now supplied in sufficient quantity, usually constantly and automatically and with mechanical guarantees that all surfaces which require it shall receive the lubricant to which they are entitled. If in these days it ever leaks out that any part of any engine or machine is not properly lubricated, it stands as a reproach against the designer, the constructor or the operator.

The application of anti-friction devices involved no new principles, but it still was waiting for the invention of details of construction or application, which latterly have been mostly supplied. The general adoption of the ball bearing was only rendered possible by the invention of the machinery which now produces the balls with such accuracy, and this machinery also was waiting more or less for the merchantable production of suitable material for the balls. Many details required in the satisfactory application of the roller bearing also have been supplied in recent years, and now we may be said to be mechanically coming into an anti-friction age. These things—the automatic or constant lubrication of machinery in general and the embodiment of anti-friction devices in the designs of machinery—have not cheapened appreciably the production of the machines they have had to do with, but they have increased their value quite materially as agencies in the application of power, which is a phase of economy as valuable as any. The lubricating habit has of course greatly increased the possible longevity of machines, which may or may not be an advantage. The machines while they last certainly are more cheaply and satisfactorily operated.

GENERAL SHOP CONDITIONS.

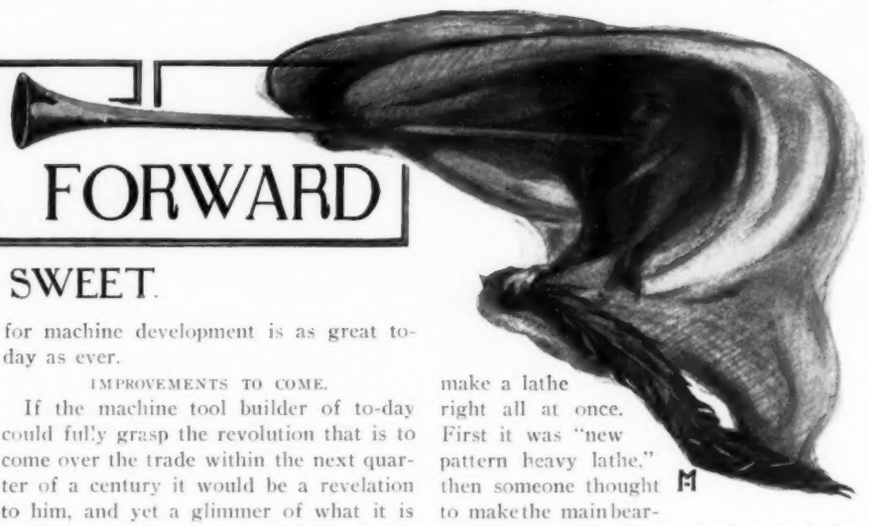
Besides the many specific auxiliaries of shop progress that may be enumerated, the one general and all-embracing one should not be overlooked. The average condition of the shop itself, of the buildings, grounds and general plant will be found to have decidedly improved. New shops have been built, some of which have served as examples for many others and have been followed to the advantage of all. Old shops have been rebuilt or remodeled or rearranged with a view to increasing the comfort of the men and facilitating their movements and the movements of the work in its progress through the shop. Shops are lighter and roomier and attention has been paid to ventilation and to the securing of a suitable temperature at all seasons. Artificial lighting when and where required is likely now to be properly attended to. Facilities are provided for storing materials where they will be out of the way until they can be used to advantage and for removing also the finished work. Shops which have been content to go backward instead of forward, or to drag along in the "good old way," have contributed to the elevation of the general standard by dropping out of existence unregretted.

CONCLUSION.

After this enumeration of some of the various agencies that have all worked together toward the improving and quickening of our methods and the augmenting of our output, an enumeration evidently far from complete and satisfactory, as, for instance, we have kept ourselves entirely within the machine shop and have not even looked into the foundry, the blacksmith shop or elsewhere to find in all commensurate impulses of progress, we are inclined to remark that it is no wonder at all that we show so marked an advance in our prices and in its results. The wonder would indeed have been if the results had not followed the causes. There may be some who may be inclined to say that we might have been expected to have done even more than we actually have.

These things have not come any of them by chance, but as the result of a constant alertness in the search for opportunity and instant readiness to appropriate it. The thinkers and the doers have been many and their work has all told. The work is by no means completed, but is to-day in full swing, and it is only a flying note of record that we make. The full accustomed force is still driving us, and this with our already acquired momentum must continue to carry us forward to the accomplishment of results still more wonderful and beneficent.

A REVIEW AND A GLANCE FORWARD



BY PROF. SWEET.

Twenty-five years, the life of the AMERICAN MACHINIST—a period one-third or one-half of its readers well remember. Multiply this by 4, or 5 at most, and it covers the time in which practically all the work accomplished by mechanics, to substitute natural forces and mechanical devices for manual labor, has been accomplished.

Before James Watt's time the steam engine was a mechanical substitute for horses. Neither the water wheel nor windmill could pump the water from the mines. The water wheel was in the wrong place and the windmill too uncertain. The windmill ground grain and pumped water; the water wheel cut logs into planks and boards and drove some cotton and woolen mills, but aside from these uses the mechanical work done was insignificant.

The steam engine put power into the hands of anyone who could pay for it, and put it where it was wanted. The world was open to inventors and the inventors were there, but they had to battle against the prejudice of those who believed, as many believe to this day, that machinery takes the bread out of the mouths of the working men; and, too, the inventors lacked tools and capital and the confidence of the money men, and yet it would be hard to say that the percentage of progress has been any greater in the last twenty-five years than in the first. In the first quarter men had to invent and make everything. In the last quarter we have had everything to do with—tools, capital and confidence—and our work has been to improve and enlarge.

ANTIQUITY OF NEW THINGS.

When we take the trouble to think back we will find that most of our new things are more than twenty-five years old. The great progress has been made in the line of electrical achievements, and in this the mechanics are entitled to as much credit as the scientists and electricians; but in this line nearly everything dates back of the quarter of a century. The electric telegraph, telephone, light and the street car service have been developed, but all are older, which leaves the X-ray, carborundum and the wireless telegraph as about the only new things in that line, the turbine engine the only new thing in engines, and in machine tools the number of little things cute and valuable are almost numberless; but of marked departures or striking originals for universal use, I do not recall one, and yet the field for machine development is as great today as ever.

IMPROVEMENTS TO COME.

If the machine tool builder of to-day could fully grasp the revolution that is to come over the trade within the next quarter of a century it would be a revelation to him, and yet a glimmer of what it is to be can be dimly seen. While all the standard machines will still be made and used, they will be built primarily to do work rather than to suit the convenience of the operator, and so improved that they will still be easier for the operator to handle. Instead of the designers studying to find out where they can take out a pound of iron and not have the machine weakened, they will study to find where they can put in another hundred and make it pay in the more and better work the machine will do. They will revolutionize the drive and feed mechanisms so the workmen can get the best of both without exertion, and they must to a large extent make the machines self-contained and true, wherever they may be set and on whatever they set, for many of the machines are to go to the work and not the work to the machines.

Great industries permit of great quantities. Special machines will be more largely employed, because then there will be pieces enough of one kind to keep one or more machines employed at a few operations or a single one, and there will be far less idle capital in long machines doing short work and larger ones doing small work. When there is enough of a kind the automatic machine will do the work, and inconsistent demands from inconsiderate workmen may in many cases develop automatic machines before even economy justifies their existence.

THE COURSE OF PROGRESS.

About the time the AMERICAN MACHINIST began to make itself known machine tool builders began to advertise their new heavy pattern lathes, exactly the thing they had been laughing at the English tool builders about, and a thing they made more prominent in their advertisements than in the machines themselves; for as a matter of fact they were only a little less ridiculous than those they had been making before, and so it has gone on, each one just a little better than the others, very little thought being expended to determine where the iron would do the most good.

No one (or few) seemed to dare to make a lathe right all at once. First it was "new pattern heavy lathe," then someone thought to make the main bearing larger and longer and advertised the fact; the next man followed, doing the best thing he could by making it larger, and the worst thing he could do at the same time—by making it longer. In the next twenty-five, or it may be only ten years, someone will have the courage to make his lathe main bearings 6 inches big and 6 inches short.

Thirty years ago the fallacy of attempting to make rigid lathe, planer and engine beds by the side plate and cross girder plan was pointed out, and at the same time the advantage of the box form and of resting upon three points was set forth. Someone is daring to adopt these ideas now. Also the advantage of one "V" and one flat over two "V" guides, which idea some lathe builders have now adopted. The importance of having a positive feed to a milling machine—equal to the importance of a rigid machine—was also pointed out. We just began to hear of geared-feed milling machines.

DARING TO DO.

When someone makes the milling machine with a spindle as large as the cutter it is to drive, and a gear in proportion, and a cutter supported close up to its sides; or a traversing machine for carrying end mills with a 12-inch spindle and a 12-inch inserted tooth cutter with blades made of 1½-inch steel, it will begin to look like the milling machine doing the work of the planer. None but the builder of national reputation can make bold departures and sell the machines. The average maker forgets that the way the other man made his reputation was exactly by these bold departures, superior workmanship and high prices.

The AMERICAN MACHINIST itself came into existence on about this plan; it dared to do and succeeded. The leading publication at the time and which had been the gospel of the mechanics for nearly a third of a century was but the advertising medium of the patent attorney, as have been other publications. The AMERICAN MACHINIST started on a different basis. It dared to publish the "Chordal" letters which other papers had refused. It dared

to say in its editorials what it thought worth while, regardless of patents or advertising.

The AMERICAN MACHINIST not only found the standard machine tools (though in feeble health), but it found the beginning of milling machines, boring mills, the turret lathe, the automatic screw machine, punching and draw presses, emery wheels, and the beginning of grinding machines and standard gages growing into an industry.

The milling machine has grown or begun to grow; the boring mill aspires to 60 feet, which is likely the limit; the turret lathe has grown fastest of all, but as it is in the direction of taking the tool to the work and not the work to the tool, the limit may not have been reached. Punching and drawing presses seem to find no limit.

To show the progress in grinding, the piston rod of the first Straight-Line engine, 1⅛ inches in diameter by 18 inches long, was sent east to be ground and cost $10; to-day the same concern would, I fancy, be glad to contract lots at 10 cents apiece.

Standard gages, micrometers and measuring machines, though not universal, are generally appreciated. Automatic machines almost in infinite variety; multiple spindle lathes; drills and milling machines, cutting and fluting in groups rather than singly; ball and roller bearings, perfected at least to a commercial success—the AMERICAN MACHINIST has seen these changes come about and helped to make them.

Better material to work and a new metal for cutting-tools are bound to force the adoption of a different class of machine tools. The best results cannot be obtained without rigid machines and positive driving power at high speed, and this may lead machine-tool builders to a consciousness of the probable fact that if the piece operated upon and the tool were absolutely rigid the cutting edge that would stand at all would stand indefinitely; or that the more nearly absolutely rigid the tool and the work are, the greater the endurance of the cutting edge.

The AMERICAN MACHINIST started with a broader field—steam engines, railroad machinery and other branches besides machine tools; to-day it is tools, where they are made and their uses. As the originators of the AMERICAN MACHINIST have passed away, so must our cherished tools. The reciprocating engine may give way to the rotary, the steam engine to the gas engine, the locomotive to the trolley, but the machine tool will go on forever.

Some small work is not thought much of, and the doers of it are apt to receive scant consideration. Never despise, however, the maker of the small paragraph in a dire emergency to fill the corner of a page. Some of the quickest work of the editor is often done in those corners, and no wonder that it does not always match what precedes it.

Echoes from the Oil Country.

EARLY EXPERIENCES OF A CHIP MAKER.

Away back in the centennial year of '76 a boy made his first start in a machine shop. To say he was a green boy would be putting it mild. I think I would be quite safe in saying he was a little bit greener than any other boy that ever tackled a shop, at least in that section of the country. Perhaps that is the reason things made such an impression on him.

Was there ever anything more beautiful and wonderful than the way that machine took the iron off? Someone said it was a lathe. Of course, there was the name on it, "Lathe and Morse." Wasn't "that Morse a great machine?" The laugh showed that the shop seemed to be partial in the use of names, but information as to why seemed to be scarce.

There were curious machines for putting holes in iron, and in due time this boy was put to work on one—not the old one, but a brand new one. The old one had a

PROF. JOHN E. SWEET,
Engineer.

lot of gears on in front and a hand-wheel that worked the drill up and down, but the new one had a wonderful way of moving the drill up rapidly and also a contrivance with a taper hole in it by which a new style drill could be used. This new style drill was intended for use only where a lot of even-sized holes were needed, and must be used very carefully.

Two things were impressed on the boy by the boss. One was that a machinist must grind the twist drills, and the other one was that in reaching around, the set-screw that held the ordinary drill must be looked out for.

For the ordinary work a lot of flat drills was provided, and when a man brought a job to be drilled he would pick out a drill from the lot and give it to the boy. If he did not find one suitable he would take one and grind it down, or else rush off to the blacksmith shop and get one flatted out to size.

Gradually they got to giving the boy the size and letting him look out for the drills, and orders like this would come: "Here, boy, drill these holes right in the center of these punch marks. Drill them five-eighths, and a sixteenth, and a thirty-second, and a sixty-fourth, scant. Hurry up with it, and bring it out to the setting-up room. Be sure you get them scant this time; the last ones were full," and away he goes, while the boy grabs a drill and starts for the blacksmith shop.

The next man on that job will demand holes "three-quarters and a half a sixty-fourth. There's no use of a man pulling his insides out to get a tap in when a thread doesn't hold much on the top anyhow," he will explain.

Night work had to be done sometimes, and for this the boy had a fine tin lamp with a glass chimney and an elegant block stood on end to set it on. Of course that block had to be some in the way, and it was quicker to reach through back of the spindle for the quick return, which was on the opposite side to the feed hand-wheel. On one occasion the set-screw head caught his overshirt sleeve and the air was filled with flying boy and lamp, and the block went over with a bang. The boy was too much astonished to yell and tried to reach up for the shipper. As it was high over his head on the other side of the machine he did not find it, and the machine was still tugging away. Finally a man came out of the gloom with a torch and got the belt off the machine and got the boy out, not much the worse for his shaking up, but minus a sleeve for both shirt and overshirt. In the discussion the men carried on he received much valuable information as to what was safe to do.

One man in the shop knew how to grind twist drills, but this man was generally too busy to grind them, except when needed for his own work. The rest of the men ground them just as they did flat ones, so the boy would try his hand at it when in a hurry. He felt very guilty for disobeying orders when the boss caught him at it one day, but had made progress enough in the art to be allowed to do all his own grinding after that.

One of the nice jobs for a boy was running the speed lathe; besides centering and drilling and reaming centers there was a lot of hand tooling to do. The small cast-iron parts that were to be polished were roughed up in the lathe and then given to the boy. He went over them with a hand tool and a piece of emery paper and had to leave a finish without scratch or chatter. As some of the shapes were quite ornamental, it took quite a degree of skill to get a good job; and after this boy had to go over a lot he had finished because they had chatter marks in them, he knew there were good reasons for never polishing until the surface was right for it. No file was allowed or needed for this job.

Anyone who wants to get a clear insight into the action of cutting tools and to

have a plain, practical demonstration of the effect of angles and of setting, can get several useful points from a hand tool.

After having a tool first refuse to cut, it it likely to grab hard and roll over and break a chunk out and give the wrist quite a twist at the same time, or it will gouge in when the rest is too far away, and perhaps bring the handle to rest under the chin. Perhaps it may jam in between the rest and the work and either spring the arbor or flip it out of the centers. When trying to feed it along the outside nicely it may take a notion to see how quickly it can get to the other end of the piece, and in doing it leave a coarse streak that looks like the beginning of a thread cut with a harrow tooth. These peculiarities of the hand tool are all very amusing (to the men and the other boys), and of great interest to the boy, if it were not for the visits of that horrid man who wants results. He wants pieces to build engines with. The boy must do more than absorb wisdom. An equivalent must be shelled out at the same time, or the opportunity to absorb was likely to be suddenly abbreviated.

Polishing the sides of nuts was another job just a little worse than facing them. Imagine taking a keg of 5/8-inch hexagon nuts, hot pressed, and facing both sides and chamfering one side, then giving the chamfer and one side a water cut that must be entirely free from scratches. Between the time of first facing and the water cuts, the nuts were dropped on to rods that filled the holes and ground up and polished on the sides. The sides of those nuts had to be kept true and the proper angle with one another. You can imagine the delight with which cold pressed nuts were received by the boy on this job.

It was a great day when he was given a real lathe, one with clutches overhead; regular claw clutches that when cutting short threads made a noise like a threshing machine, and that once in a while had a fashion of going to pieces. It was a nice trick to know just when to throw out, so that the lathe would stop without running the tool up against the center and breaking the point off, and just as nice a one to be able to stop without see-sawing back and forth for a while.

Trying to help the lathe stop at just the right place gave the back gears a chance to put the machinist's trade-mark on one of the boy's fingers. "You won't be a good machinist until you get at least one finger off or chewed up." He had heard that when he first started in, and has heard it many times since.

Not having been raised in a mechanical atmosphere, it seemed necessary to this boy that he improve every chance to learn, and he was always ready to ask questions. It was not long until he began to find that the answers coming from different men did not agree, and he began to look around for something that would be settled. *The Scientific American* was recommended to him, but it had too much general science and too little shop knowledge. A book that he put $2.50 into (and that is a large amount of money to a boy who is paying his way on 50 cents a day) proved to be a sort of general receipt book of little value. Only those who have needed knowledge without knowing where to get it or what value to place on the information as gathered from the men around him, can appreciate the satisfaction with which the boy began to see copies of a new paper and hear the men talk of it. This boy was, mechanically, quite young when the AMERICAN MACHINIST began to make its appearance, and the things that appeared there seemed to come with more force than when told by the men.

When "Extracts from Chordal's Letters" began to appear, it began to dawn on him that the shops around him were just such shops as the paper was telling of, and things that could be done in them could be done in these shops, too, because Chordal was surely writing of some of the shops he had been in, and he had seen some of the very men—didn't have to go very far either.

"Here, lad, you are always ready for something new; grind in the valves on this pump on the water end." The boy was given some ground glass. The valves and seat were badly rusted and progress was slow.

"If you would get some sand and use water you'd get along better." That was Aleck.

"Nothing but oil and emery is any good on that." This was Jake.

"Not any use of wasting time that way; they should be taken out and faced before trying to grind them." Dan was passing by.

"Just a waste fooling with them; they would hammer to a good seat in a short time." Scotty had worked in a job shop.

"It takes experience and judgment to do such a job, and I think the foreman made a mistake in putting you at it," and Sam passed on to the blacksmith shop.

"You must put your weight on it and turn both ways." The illustration Billy gave of his meaning was a big help.

"If you will keep at it and not stop to listen to everyone that comes along you may get done some time; you should have a mind of your own." Pat was one to look up to with respect.

"Gee, wouldn't I hate to have to pay for that job!" Charley was only a cub though, and didn't count for much.

A man was put on to help finally, and the air began to be filled with speculation as to who knew enough to set the valve on the steam end, which was well known to be an operation shrouded in so much mystery that it took a man with much ability and previous experience to perform it successfully. The first man that tried it failed; the second one made the pump run by jumps. The third man knew how all right enough, but didn't care to explain it to anyone.

Of course, several who hadn't a chance to try it knew just how to do it, but somehow their disp tes among themselves as to how to go about it did not give much light on the subject. Although the boy felt the need of light and tried hard to get it, the ideas he gathered were very far from correct.

Perhaps you think these things happened in some little, out-of-the-way shop, away behind the times, but not so. The shop was a large and successful one, and by all odds the best one in that section, and the men were better than the average, so far as being well informed was concerned. At that time it was not the easy thing to get good and reliable information on all branches of the trade as it is to-day.

There is an old saying, "You shouldn't blame a man for what he doesn't know." Now, that just depends. If it is reasonable that he should know it, then he is to blame for not knowing it. There are some tools that every machinist is supposed to have of his own, and he would never put it up as an excuse for not being able to do work that he didn't have them; but should he be unable to borrow them he will buy them, and he generally gets good ones while he is doing it.

The boy of whom I have been telling you found men in the shop who advised him not to buy tools. "You're learning the trade and working for little wages; make the boss furnish the tools." He did not follow that advice and continued buying tools and books and papers, and while he bought some of each that were of very little use to him, he found on an average it was money well spent.

Cold-rolled shafting had not yet found its way to this shop, and all studs and finished bolts were made by being centered and turned up and threaded in the lathe. What a lot of experience there was in a lot of studs—enough for twenty-five steam engines.

Quite a number of ½-inch studs, 2 inches long, were used, and to make them more cheaply a lathe had a hole drilled through the spindle, a drill chuck something like the "Little Giant" of to-day was made. It was arranged to screw on to the spindle, and the jaws were threaded to catch ½-inch threads. Long pieces of ½-inch round iron were threaded up in the bolt cutter and then cut to length in the lathe. This cutting to length was a nice job for the boy. The jaws of the chuck were not any too good a fit, and it was a nice trick to cut the pieces off quickly and still not have the stock slip. If it did slip it meant a broken tool, as it would screw into the chuck and snap the tool off. The man who had to file up a new tool would generally try to impress it on the boy that he was a little the dumbest boy in the county and that a smart boy would never break a tool, while the men who came by while he was cutting them off often tried

to convey the impression that any other boy could cut pieces off at least twice as fast.

Once the boy was busily engaged trying to see how hard he could crowd the tool without having the stock slip, when suddenly it started to screw rapidly into the chuck. Snap went the tool as the boy made a grab for the shipper and jerked the clutch out, but not before the air was filled with yells. "Ouch! Help! Murder! When I get hold of you I'll warm you up, you little"——"What are you hollering at him for, you big lunkhead; better watch where you're going the next time," broke in one of the men who was trying to untangle him.

"Never you mind, lad, he won't touch you; he was so badly scared he had to yell something," said another to the boy, who stood with scared face and trembling legs, worse frightened than when he had been pulled into the drill press himself.

That threaded piece had extended across a passage way, and the young man had walked against it without seeing it, and it had promptly begun winding his shirt sleeve up. In his first terror he had thought of someone he had seen getting badly hurt, and yelled. He had a nice row of gashes on his arm and the sleeve needed a patch, while, everybody being busy, the boy got a chance to file up the tool.

Most of the boys used to have trouble with the blacksmith, who was not slow in grabbing one of them by the neck and helping him out; but this boy soon found that a little patience and politeness were not wasted, and soon felt indebted to him for many little scraps of information on the art of tool dressing and tempering, and when things were not too crowding would be allowed to put a tool in the corner of the fire and try his hand with it.

There are still enough shops that cling to the old ways and tools to show the new generation some of the old light tools of that day if they care to look for them and make comparisons, but there is one thing they can hardly know and that is the difference in the chance to become posted as to the best theory and practice of the trade.

At that time the AMERICAN MACHINIST had just started, and the hand books then out were for civil engineers or steam engineers. There were no correspondence schools and the colleges were too busy educating gentlemen in things to be forgotten to descend to trade. The shop boy who was after knowledge had to dig for it and he didn't have nearly the help to dig nor the nicely prepared places that are at hand to-day.

One of the most discouraging things that the boy—the one I've been telling of—finds to-day in looking around the shops is the little value that is set on these opportunities. A boy that will spend three years or more of his life learning a trade and never read a trade paper is surely illy informed. He works through his time giving up the difference between a laborer's and an apprentice's wages for the chance to learn. This will usually amount to several hundred dollars. He can find money to buy novels and can go to the theater and have a good time in other ways. He generally has a fair supply of tools. It cannot be that he cannot raise the necessary amount of money to buy the paper, but if he only knew it, that same paper will furnish him with the most valuable tool in his outfit.

People who dislike to carry responsibility and get better wages than the average should be careful and not read or study any trade literature. People who grumble for fear they won't get their money's worth if they take a paper never have a good kit of tools Very few people expect to use one pair of calipers for all jobs, big or little; why should they expect *everything* in the paper to be of interest to them and their work—there are others.

The AMERICAN MACHINIST is now twenty-five years old, and is a good tool to use; comes in handy in any shop and on all sorts of jobs—a regular universal tool; good alike for the beginner, the amateur, or the expert.

Perhaps you know more on some subjects than anything it has ever published. You are the one that boy is waiting to hear from. He may need it on his next job. If you all will print what you know, that boy may know lots he should know before another twenty-five years are gone, and if you don't he may never find out about them in any other way.

W. OSBORNE.

Legal Notes.

WHEN TITLE TO MACHINERY PASSES.

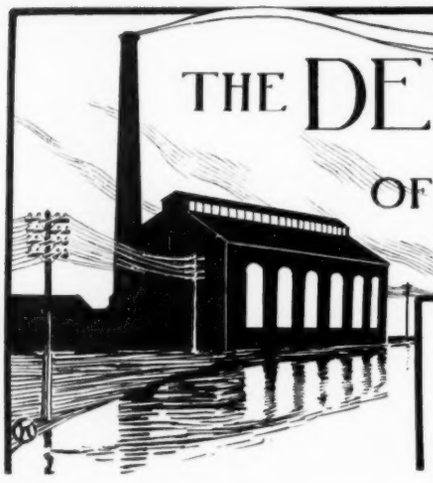
The exact time at which title to a machine passes from seller to buyer occasionally has an important bearing upon the interests of the former if something happens to the buyer before the purchase price has been paid. A case involving such a question was recently decided by the Supreme Court of Vermont. It appeared from the evidence that the Kitson Machine Company, a manufacturer of textile machinery in Lowell, Mass., had contracted to install certain machinery at the mill of William Campbell. It was agreed that the company should furnish the machines for so much, delivered free on board at Bennington whenever Campbell desired and set them up and put them in running order in Campbell's mill at the company's own expense; Campbell to furnish the necessary help and labor and pay board of man while erecting machines.

The machines were shipped to Campbell at his request, the bill of lading was made to him and the freight was prepaid by the Kitson Company. On their arrival at Bennington Campbell took them to his mill and subsequently insured them by one or more policies which in terms covered all the machinery in his mill. The Kitson Company sent men to set up and start the machinery, and they were doing that work when Campbell died, upon which they stopped. Soon after this the Kitson Company replevied the machines from Campbell's administrator, John S. Holden. Upon trial of the case the court held that the contract being silent as to time of payment, the sale was for cash on delivery, and before the title passed. It consequently refused to order the return of the replevied property to Holden or to submit that question to the jury, although it did indeed order a verdict for costs in favor of Holden, because the Kitson Company had not made a demand for the machines before replevying them.

On appeal to the Supreme Court this judgment has been affirmed. The defendant, Holden, had contended that the contract did not require the Kitson Company to set up the machines, but only to bear the expense, which Campbell or he could waive, the sale being complete without it, and that the title passed on delivery of the goods at Bennington. But the Appellate Court holds that it was a part of the contract for the Kitson Company to set up the machines in order to put them into a "deliverable condition." The defendant also contended that the question whether the parties intended title to pass on delivery at Bennington, thus implying a waiver of cash payment on the part of the plaintiff, should have gone to the jury. But the Appellate Court does not think so, since the circumstances precluded the question. The machines had to go into Campbell's possession for the work of erecting to be done, so this was not an unconditional delivery to him as vendee. Campbell might have released the company from the further performance of the contract, but he did not, for the work was being carried out when he died.

Waterproofing Blueprints.

The waterproofing medium is refined paraffin, and is applied as follows: A number of pieces of absorbent cloth, about a foot square, are dipped in melted paraffin until thoroughly saturated; when withdrawn and cooled, they are ready for use. One of the saturated cloths is spread on a smooth surface, the dry print is placed on it, and a second waxed cloth on top. The whole is then ironed with a moderately hot flat-iron. The paper immediately absorbs the paraffin, and becomes translucent and waterproof. The lines of the print are intensified by the process, and there is no shrinking or distortion. As the wax is withdrawn from the cloths, more can be added by melting small pieces directly under the hot iron. By immersing the print in a bath of melted paraffin, the process is hastened, but the ironing is necessary to remove the surplus wax from the surface, unless the paper is to be directly exposed to the weather and not to be handled.—*The Inventive Age.*



THE DEVELOPMENT OF POWER PLANTS

BY FRED. R. LOW

When the AMERICAN MACHINIST was founded, a quarter of a century ago, the typical mill engine consisted of a pair of cylinders of the same diameter operating cranks set at 90 degrees upon a main shaft carrying a large belt wheel or gear at its center. The engines were mostly of the four-valve automatic cut-off type with a stroke of twice the diameter or longer, running from 450 to 500 feet of piston speed, and with 70 or 80 pounds pressure. These engines rarely ran larger than 34 inches in diameter with a rated capacity of 1,000 horse-power. For anything too small to warrant a four-valve engine, the plain slide valve with a throttle governor was used, and these were sometimes provided with a riding cut-off valve adjustable by hand, giving the engineer control of the point of cut-off, but regulating by throttling, a type which later developments indicate may be better than was supposed.

The movement in the direction of high speeds had already commenced. Charles T. Porter and John F. Allen had exhibited at the London Exposition of 1862 an 8x24-inch engine running at 150 turns per minute, and in Paris in 1867 others running at 200 revolutions, which were passed by the judges with the flippant remark that they would run themselves to pieces before the Exposition was over. John C. Hoadley had upon the market a single-valve automatic engine with a shaft governor. At the Centennial Exposition, at Philadelphia in 1876, the Buckeye engine, the product of Mr. J. W. Thompson, came first prominently before the public. Professor John E. Sweet had exhibited at Philadelphia a Straight Line engine built at the Cornell University shops and embodying the shaft governor, with swinging eccentric, and the balanced multiported valve, which make it the progenitor of the numerous family of single-valve automatics which have now become so prominent a factor in the field. The early closure of the exhaust valve on short cut-offs, inseparable from the use of such a valve, becomes an advantage at high speeds; the multiported valve gives an adequate port opening even with early cut-offs, and the shortened travel and balancing feature places it under the easy control of the governor.

Early in the period in question the commercial practicability of the mechanical generation of electricity was demonstrated and a demand developed for engines to run dynamos. Here was the opportunity of the high-speed engine with some refinement in regulation. Armington & Sims, who had the benefit of association with Hoadley in his efforts along this line, were among the first in the field with a practicable single-valve automatic of high rotative speed. Mr. Frank C. Ball exhibited at the Charitable Mechanics' Fair at Boston, in 1883, an engine driving a dynamo, in which the valve which now distinguishes his engines was used and in which there was added to the shaft governor a member operated by the belt tension to obtain a more prompt response of the engine to the load. Improvements in the shaft governor soon rendered this complication unnecessary.

This type of engine, the single-valve automatic, on account of its simplicity, compactness and low first cost, and its superiority in efficiency to the plain slide valve with little expansion, has found a wide field in small and medium powers, and is used in considerable sizes where the qualities mentioned outweigh the consideration of the highest attainable efficiency.

The advantages of the compound engine were at this period by no means generally recognized. In his report upon the engines of the Centennial Exposition, Dr. Charles E. Emery says: "It is still strenuously denied by many that greater economy can be secured with a compound engine than with a long-stroke single engine using the same pressure."

The first compound engine for factory purposes was installed at the Social Mills at Woonsocket, R. I., in 1883. It was built reluctantly by the Corliss Steam Engine Works, and has cylinders 20 and 36 inches in diameter, a stroke of 72 inches, and runs at 60 turns per minute with 150 pounds working pressure. By its use the coal consumption for all purposes was cut down to 1.62 pounds per hour per horse-power.

Multiple-cylinder engines soon came into favor and the principle was carried to an extreme in the construction for the Warren Manufacturing Company, of Warren, R. I., of a quadruple expansion engine having cylinders 24, 36, 52½ and 64½ inches in diameter with a stroke of 72 inches. It was sold on a guarantee to develop a horse-power on 14 pounds of steam per hour at 120 pounds pressure, and did better, although it never developed any exceptional efficiency, never having had an initial pressure higher than could have been taken care of nicely with a two-stage compound. In fact, it has developed that with the pressures available in stationary work there is little to be gained in going above two stages, and current practice, even for pressures approaching 200 pounds, is to put in compound engines with a large cylinder ratio rather than triple expansions, except under the uniform conditions of service which obtain in pumping and marine work.

In the beginning, electrical generators were designed to run at speeds exceeding those even of the high-speed engines, and belting was used between the engine and the generator. The first large electric railway station—that of the West End Railway at Boston, installed in 1890—had thirteen 23 and 36x48-inch engines running at 68 turns per minute, belted to jack-shafts, from which the generators were run with another set of belts. This installation has already been converted, at a great sacrifice in investment but with a proportionately great increase in efficiency, to the modern direct-connected vertical engine type.

The generators were soon, however, brought down to the speed of the high-speed engines and their armatures direct connected to their shafts, and, finally, the generator has been brought down to the rotative speed of the large engine with the detachable cut-off, so that at present the electrical generator and its engine are combined in a single machine in all capacities. It is to be remarked that Ferranti anticipated this development in the 10,000 horse-power units designed in 1887 for the Deptford (England) station, which consisted of two vertical Corliss engines of 5,000 horse-power each, direct connected to a 40-foot generator. Current was to be generated at 10,000 volts with step-down transformers. His system, designed at that early date and when he was but twenty-four years of age, had all the essential features of the great direct-connected units of to-day, and would probably have been successful had the people behind it had the confidence to carry it out.

With the increase in the demand for electricity and the building of stations of great capacity came an increase in the size of the units, and it is but natural that these large engines should follow the lines of the large units previously built for marine propulsion. The services are not dissimilar, the turning of a shaft with, in one case a screw, and in the other the moving member of a generator attached. There is the same problem of carrying the large low-pressure pistons, which is more easily accomplished in a vertical cylinder than when their weight is carried on the cylinder wall, and there is present, though to a lesser degree, the problem of getting a large amount of power into a limited space. The engine which is now generally installed in the great stations requiring large units is therefore the inverted marine type. The largest units, of 8,000 horse-power, are, however, made up of two compounds attached to a single shaft, the low-pressure cylinders set vertically over the ends of the shaft and the high-pressure cylinders lying horizontally, taking hold of the same pin with the low pressures.

The demands of large street-railway systems for electric power and of cities for electric light have led to the installation of stations of great capacity, in which the magnitude of the operations involved warrant the adoption of all that is best in power-producing appliances. The following table gives the leading features of four of these great stations in New York city:

	Metropolitan.	Manhattan.	Kingsbridge.	Edison.
Engines	11	8	16	16
Horse power each, normal rating	4,000	8,000	4,400	5,200
Maximum rating	6,600	12,500	7,000	8,000
Ratio maximum to normal rating	1.65	1.56	1.59	1.54
Aggregate normal rated horse-power	44,000	64,000	70,400	83,200
Aggregate maximum rated horse-power	72,600	100,000	112,000	128,000
Diameter high pressure cylinders	46 in.	44 in.	46 in.	43.5 in.
Diameter low pressure cylinders	86 in.	88 in.	86 in.	75.5 in.
Volumetric ratio	3.5	4	3.5	6.02
Displacement per min. low pressure cylinders aggregate	332,795.8	506,843	484,066.6	707,149
Displacement per min. low pressure cylinders per normal H.P.	7.56	7.92	6.88	8.5
M. E. P. required to develop normal rated H. P.	30.31	28.94	33.31	26.56
Reheating surface each engine		1,544		1,137
Reheating surface per normal H. P.		.193		.219
Boilers	87	64	60	56
Rated horse-power each	250	500	512	650
Rated horse-power aggregate	21,750	32,000	30,720	36,400
Ratio boiler to engine H. P. normal rating	.49	.5	.436	.44
Heating surface aggregate	205,291 sq. ft.	335,570 sq. ft.	307,200 sq. ft.	364,000 sq. ft.
Heating surface per rated boiler H. P.	9.44	10.5	10	10
Heating surface per rated engine H. P.	4.67	5.24	4.36	4.37
Grate surface aggregate	3,991 sq. ft.	5,632 sq. ft.	6,600 sq. ft.	6,720 sq. ft.
Grate surface per rated boiler H. P.	.183	176	.21	.18
Grate surface per rated engine H. P.	.0907	.088	.094	.0808
Boiler horse-power per sq. ft. of grate	5.45	5.68	4.65	5.4
Engine horse-power per sq ft. of grat	11.02	11.36	10.67	12.4
Ratio heating to grate surface	51.4	59.58	46.5	54.17
Working pressure	150	150	160	175
Chimneys	1	4	4	4
Hight above lower grates	353 ft.	278 ft.	225 ft.	200 ft.
Internal diameter	22 ft.	17 ft.	14 ft.	17 ft.
Aggregate area	380.13	907.92	615.76	907.92
Area × hight	7,141.99	15,138.05	9,236.4	12,839.93
Ratio grate surface to chimney area	10.5	6.2	10.7	7.4
Feed Water Heating Surface—Economizer		98,304	115,200	
Exhaust { vacuum (primary)			24,000	
Exhaust { atmospheric (secondary)				10,664
Aggregate heating surface		98,304	139,200	10,664
Aggregate per boiler H. P.		3.072	4.5	.293
Ratio boiler to economizer surface		3.41	2.7	
Ratio boiler to total feed water heating surface		3.41	2.2	34.14
Condensers—Kind	Surface.	Jet.	Jet.	Surface.
Number	11	8	4	16
Cooling surface aggregate	88,000 sq. ft.			147,200 sq. ft.
Cooling surface per normal H. P.	1.6			1.77
Ratio boiler to condenser surface	2.33			2.47
Coal Storage Capacity	9,000 tons	15,000 tons	15,360 tons	10,000 tons
Per boiler horse-power	827 lbs.	937 lbs.	1,000 lbs.	549 lbs.

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Improvement in engine efficiencies has been in the average more than in the maximum, although there has been a substantial lowering of the record in steam consumed per unit of power developed.

Dr. Charles E. Emery, in his report on the engines of the Centennial Exposition of 1876, cites the Lawrence Pumping engine as containing all well-known means for securing maximum economy of steam and says "it is probable that few, if any, engines are working with greater economy in respect to the indicated power." This engine, with 90 pounds initial pressure, required 14.02 pounds of steam per hour per indicated horse-power.

Reynolds triple expansion pumping engines at the New Milford station of the Hackensack (N. J.) Water Company are said to develop an indicated horse-power on 11 pounds, and a number of examples can be cited of consumptions between 11 and 12.

Of more importance, however, than this increase in the efficiency of exceptional units is the general improvement in efficiency due to the general use of higher pressures and compound engines. Common figures in the early 80's were 30 pounds of steam per hour per horse-power for non-condensing and 20 for condensing mill engines, while the small slide valves with throttling governors took anywhere from 45 upward. Large compound condensing units are now sold under guarantees to produce an indicated horse-power on between 12 and 13 pounds of steam per hour; smaller and simpler units run readily on 15 pounds, high-class non-condensing engines run on from 25 to 28, and for moderate amounts of power the single valve automatic compounded is available with a consumption of from 30 to 35 pounds simple non-condensing, 26 to 28 pounds compound non-condensing, and 18 to 20 pounds with a condenser.

In 1889 Mr. Charles H. Manning placed the cost of a horse-power at $19.24 per annum. Dr. Charles E. Emery in 18 5 placed it at $15.00. Mr. Frank Sheldon in 1897 presented statistics from the New England cotton mills, in which the cost varied from $11.64 to $14.85, and the Warren (R. I.) Manufacturing Company reported their cost as only $11.55. The items of this cost are presented in the following table:

	Manning Per Brake H. P.	Emery.	Sheldon Lowest.	Sheldon Highest.	Warren.
Fuel	$9.49	$4.60	$4.76	$6.60	$4.70
Attendance	2.44	1.35	2.34	2.71	1.88
Supplies	.23	1.85	.31	.51	.42
Repairs	1.31		.19	.31	
Fixed charges	5.77	7.20	4.04	4.72	4.55
Total	$19.24	$15.00	$11.64	$14.85	$11.55

Even Mr. Manning's cost, which, it is to be noticed, is per brake horse-power, is considerably below that at which the average mill was producing its power at the commencement of the period of which this article treats. The principal difference between his estimate and the other results is in the fuel item. His figure is based on 1.75 pounds of coal per horse-power hour, including all coal used for starting and banking. The average engineer of 1877 thought he had a good record if he got along with 3 pounds. His coal cost per ton is $4.50. At Warren 1.5 pounds of coal costing $2.26 per ton are used per horse-power hour and they run 20 hours less per year. Another factor which has brought down the cost is the increase in size of the units. Mr. Manning's figures are based on 1,000 horse-power net, 1,100 indicated, while the Warren engine has a rated capacity of 2,000 horse-power, making a serious reduction in the cost of attendance per horse-power. The great difference in the fuel item is indicative not of a general reduction in the price of coal, but comes from the use for steam-producing purposes for bituminous coal and the smaller sizes and cheaper grades of arthracite which were formerly regarded at the mines as waste.

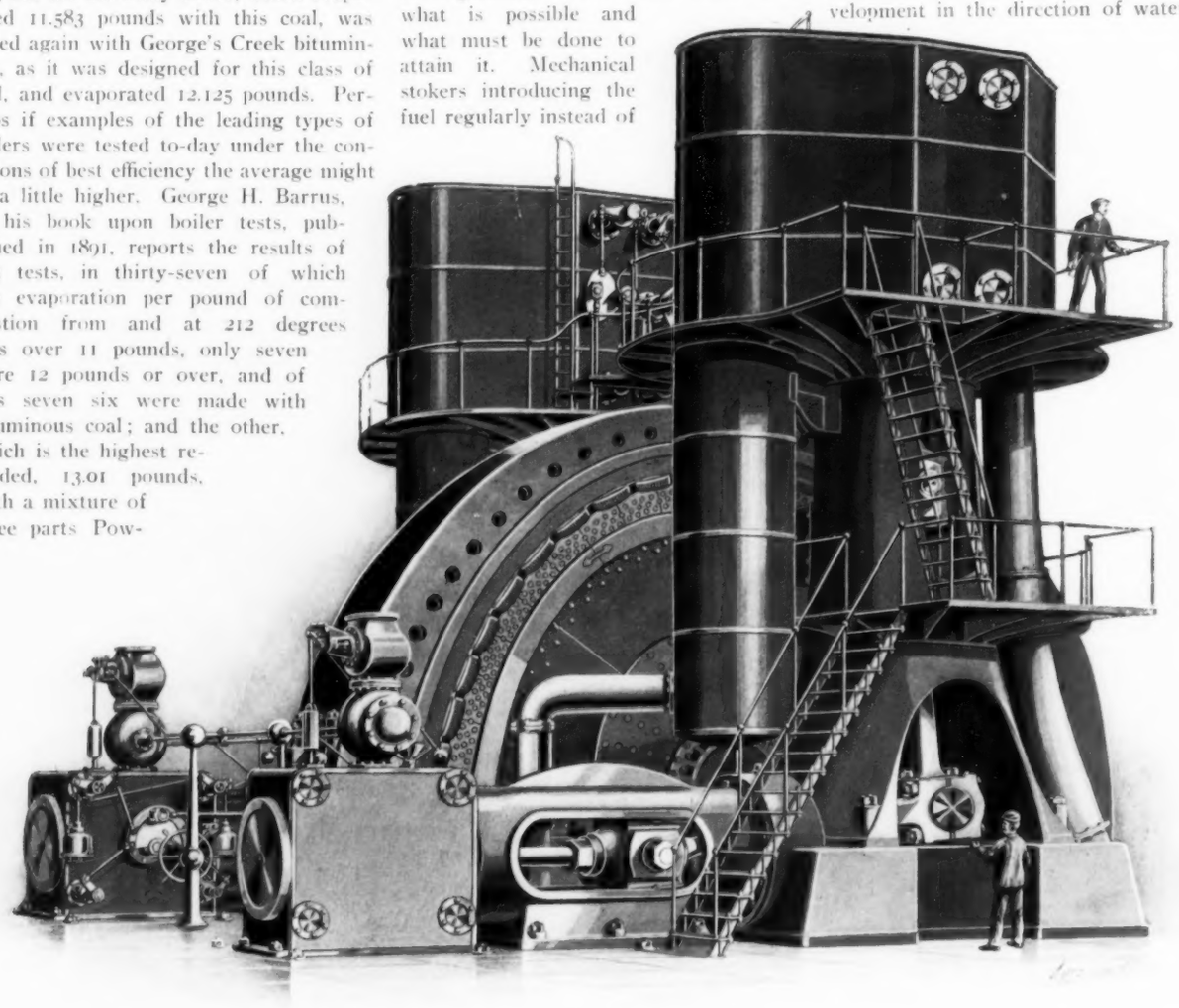
The improvement in boiler efficiency has been less marked than in that of the steam engine. At the exposition of 1876 economy and capacity tests were made of fourteen boilers there exhibited, under the direction of Dr. Charles E. Emery, Charles T. Porter and Joseph Belknap, the evapo-

ration per pound of combustible from and at 212 degrees was as follows:

10.834	.....	10.041
10.930	.....	11.923
11.988	.....	11.822
9.613	.....	11.906
11.039	.....	11.583
12.094	.....	10.618
10.312	.....	10.021

Minimum—9.613.
Maximum—12.094.
Average—11.05.

The tests were made with anthracite coal from the Lea Colliery, Wilkes-Barre, Pa., but the Galloway boiler, which evaporated 11.583 pounds with this coal, was tested again with George's Creek bituminous, as it was designed for this class of fuel, and evaporated 12.125 pounds. Perhaps if examples of the leading types of boilers were tested to-day under the conditions of best efficiency the average might be a little higher. George H. Barrus, in his book upon boiler tests, published in 1891, reports the results of 133 tests, in thirty-seven of which the evaporation per pound of combustion from and at 212 degrees was over 11 pounds, only seven were 12 pounds or over, and of this seven six were made with bituminous coal; and the other, which is the highest recorded, 13.01 pounds, with a mixture of three parts Pow-



8,000 HORSE-POWER UNIT AT THE MANHATTAN (NEW YORK) POWER STATION.

elton bituminous and 1 part pea and dust. Wm. Wallace Christie collated for the American Society of Mechanical Engineers in 1897 the results of 224 boiler tests, including those of Barrus, in 103 of which the evaporation from and at 212 degrees was 11 pounds or over, in twenty-nine cases 12 pounds or over, and in seven cases 13 or over. Five of the seven cases were on internally fired vertical boilers and two on horizontal boilers, and all with bituminous coal. Of twenty-nine cases in which the evaporation was 12 or over, twenty-one were with bituminous coal. As these tests were made under all sorts of conditions and with all sorts of fuel and include the earlier as well as the later practice, the minimum and average efficiencies do not mean anything. The maximum was 13.4.

While there has been thus little improvement in the efficiency attainable by the steam boiler, it is probable that the average efficiency has been considerably improved, and the actual coal consumption per pound of steam produced considerably reduced. Boiler plants are better organized, a better idea exists as to what is possible and what must be done to attain it. Mechanical stokers introducing the fuel regularly instead of intermittently, and providing for its complete combustion, economizers to return to the system a portion of the heat formerly allowed to pass off with the products of combustion, feed water heaters to return to the plant heat that formerly went off in the engine exhaust, have all reduced the coal per horse-power, while not showing in the equivalent evaporation from and at 212 degrees. Much more attention is paid to the use of exhaust steam for heating and manufacturing, and in cases where low pressure steam must be had for these purposes power is obtained at a nominal cost by generating the steam at a high pressure, and using it in an engine which exhausts at a back pressure sufficient for the purpose, the engine serving simply as an expansion or reducing valve. No one any longer runs an engine condensing when there is use for exhaust steam. Heaters are used even between the engine cylinder and the condenser, and the condenser is in some cases used as a heater for water to be used in manufacturing processes.

The movement in the direction of high pressures and of large units has led development in the direction of water tube boilers. The fire sheets of a shell boiler must not exceed a certain thickness, and only at comparatively small diameters are they safe under high pressures. But small diameters mean limited capacity. The horizontal tubular boiler is regularly listed only up to 200 horse-power and reaches its limit at about 400 horse-power, while the water-tube boiler may be had in thousand horse-power units, and on account of the subdivision of its contents is safer than the shell type. No particular type can be claimed to hold the palm, as a

boiler of either type can be so designed, proportioned and adapted to existing conditions as to realize the highest attainable efficiency. Perhaps this is most easily and often done with an internally fired boiler. Isherwood claims 10 per cent. advantage for that type over the boiler set in brickwork in its ordinary condition, and F. W. Main, in a paper presented before the American Society of Mechanical Engineers in 1897, summarizes the reduction in the cost of steam power from 1870 to that date as follows:

	Per cent.
Improved engines and higher pressures	37
Vertical engines (saving in friction)	5
Vertical internally fired boilers	7
Improved grates	2
	51

Superheating is just commencing to make its appearance upon this side of the water in a tentative way, over 100 installations having been put in, taking the form of supplementary superheating surface in the boilers themselves rather than of superheaters over separate furnaces, although for some conditions the superheater with separate furnace has marked advantages, and promises an increase of steam efficiency if the working fluid can be heated sufficiently to seriously diminish initial condensation. As compounding, jacketing, etc., are designed to diminish the same losses, the gain from its use is less pronounced in high-class than in simpler engines, and it remains to be proven how far it can be carried without introducing practical difficulties which will offset the lessened steam consumption. Results from abroad are reported as low as between 9 and 9.5 pounds of steam per horse-power hour, but data of the cost of supplying the superheat, and thus of the ultimate economy, are difficult to obtain.

The use of superheated steam is likely to lead, on account of the lessened difficulties of lubrication, to the employment of the poppet valve, abandoned by American engine builders with the adoption of the Corliss.

The most radical departure during the period in question is the recent development of the steam turbine. This, the earliest known form of the steam engine, was for more than a century set aside by the reciprocating piston engine, which was more nearly within the mechanical capacity of the times. Better tools and workmanship and familiarity with high speeds and the requirements of their successful employment have led to a revival of this simple form of motor which contains all the elements of efficiency and bids fair to become a formidable rival of the reciprocating type. Two forms are now upon the market, the Parsons and the De Laval, while a third, the Curtis, is about ready to be launched. Steam consumptions approaching those of the best compound engines are obtained by their use, and they appear particularly adapted to develop the advantages of superheating.

The life of the AMERICAN MACHINIST extends over the practical development of the gas and oil engine, for it was not until 1876 that Otto brought out his "silent" form, which is the prototype of most of those now upon the market. For a long time considered practicable for but small powers, it has within the past few years developed enormously both in numbers and capacity, engines as large as 1,000 horse-power being in actual use, and units of 2,000 horse-power being projected. The adaptation of this form of generator to the use of oil as fuel has enormously increased its field, and its use with blast furnace gas, hitherto imperfectly used under boilers, etc., has been successfully accomplished abroad and will be shortly undertaken in this country.

FRED. R. LOW,
Editor of *Power*.

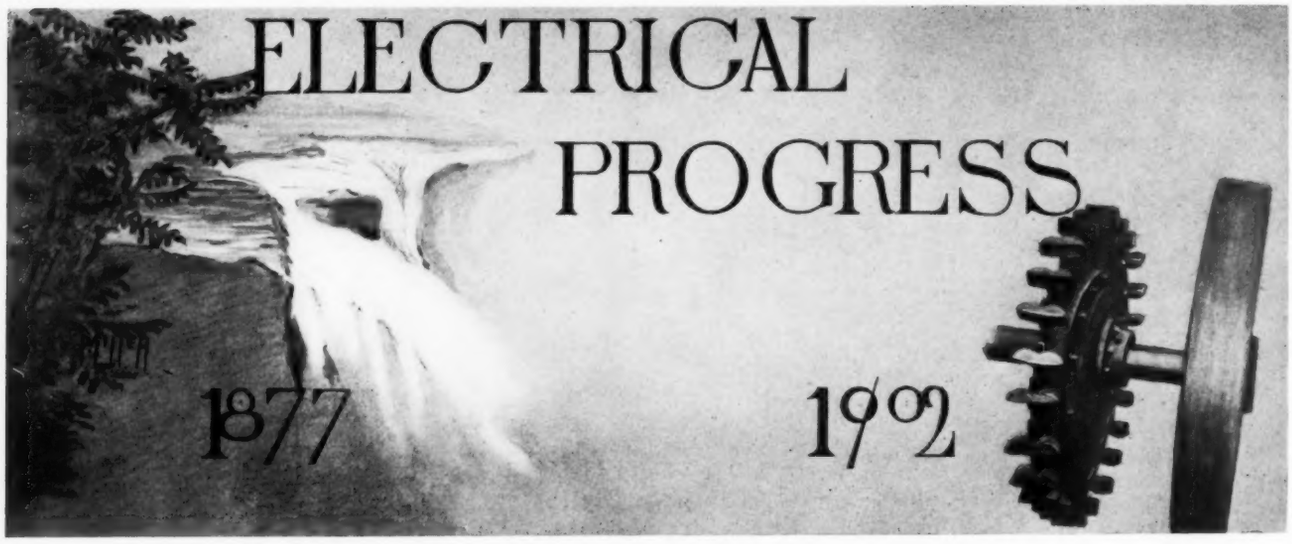
Our First Readers.

We naturally have a kindly feeling for the veteran readers of our paper who began their reading with the first issue and have kept it up ever since. We have received word from quite a number of these, all expressing satisfaction over the long companionship and indicating generally that the world has not used them ill. We are glad to believe that they have been helped and encouraged as we have been by the association. These first readers of ours are not now numerous, and yet their greetings have come to us from Maine, California, Texas, Michigan, Kentucky, besides the manufacturing States, the greatest number being from Ohio. Mr. O. Canuteson, Waco, Texas, says that but one copy of his paper has been lost in the mails in twenty-five years. Many of these writers note that they have nearly complete files of the paper from the beginning. The following from Warner & Swasey, Cleveland, emphasizes in a way one of the most notable business successes: "Mr. Swasey remembers very pleasantly his conversation with Mr. Horace B. Miller, who visited the shops of the Pratt & Whitney Company in reference to the first issue of the AMERICAN MACHINIST, which was then being started to, in a measure, take the place of the *American Artisan*. Both Mr. Swasey and Mr. Warner have been constant readers of and subscribers to the paper since that time." Another, who is now a valued contributor, began to work in the shop and to take the paper in the same year, and he writes: "I attribute no small share of my success to information I have received through a study in it of such subjects as touched on my line of business." One writing from Ohio—a superintendent of a large works—says: "I have read your paper from the beginning and shall continue to do so as long as you continue to give the same attention to the needs of the shop man that you have in the past." Another, from Pittsburgh, says: "I cannot recall one single issue that has not contained something that I have regarded as more valuable than the price of the paper." One from New York State says: "I feel like a man without his dinner when my news agent does not get it on time." Mr. *Church*, of Norwalk, Conn., says he has saved all except the first and latest numbers for future reference. "My first number was lost at the bindery, the other was badly mutilated by my newest little *Chapel*, who was enjoying a still hunt for the baby buffalo on the back cover." The kind words from these old readers do not all belong to the present conductors of the AMERICAN MACHINIST, but they add largely to the incentives to the maintenance and advancement of our standard of excellence, and we can only hope that twenty-five years hence the results of our present labors will be spoken of in terms of such high appreciation.

Readers have generally also been to a greater or less extent contributors. No person who takes much interest in machinery can always and continuously resist the impulse to take part in discussions that are going on, and those who may think that one who has done creditable work as an engineer or mechanic should keep quiet about it should carefully read what Rear-Admiral Melville has to say on that subject in his article printed elsewhere in this issue.

Mr. Dooley on Machinery.

What's masheenery done f'r th' wurruld? says ye. It's done ivrything. It's give us fast ships and an autymatic hist f'r th' hod, and small flats, an' a taste of solder in the peaches. If annybody says the wurruld ain't better off thin it was, tell him that a masheen has been invinted that makes honey out if pethrolyum. If he asts ye why they ain't any Shakesperes to-day, say: No, but we no longer make sausages by hand.



By THOMAS COMMERFORD MARTIN.

Twenty-five years ago, outside the domains of telegraphy and telephony—the latter then barely in existence—the investment in electrical development reached possibly a million dollars. To-day the arts of electric light, heat, power and transportation, dependent upon current from generators driven by steam engines, gas engines and water wheels, represent a capitalization of $3,500,000,000. Stray beams of electric light had shone faintly on the great Philadelphia Centennial, and there, too, were heard the feeble whispers of the first telephone; but in 1877 the whiz of the trolley car was still unknown, and not a factory manager in the land had the remotest conception of the use of electric power. All the great practical advances of the quarter century had, it is true, been foreshadowed, outlined, suggested or experimented with in philosophical laboratories or by poor and prescient genius; and the success of land and sea communication by wire had indicated strongly that "the greater lay before." Yet it was reserved for the period celebrated by this commemorative issue of the AMERICAN MACHINIST to witness the fruition of dream and prophecy, and to record the brilliant triumphs of Edison and Brush, of Bell and Sprague, of Elihu Thomson and Nikola Tesla, of Edward Weston and William Marconi, of Van Depoele and Stanley.

It has lately fallen to the lot of the writer, who had the good fortune to participate actively in all this development, to compile for the United States Census Office the figures of electrical manufacturing in this country. The data, just published, show a production of nearly $105,000,000 in 1900, and increasing at a rate of 20 per cent. annually. The curious fact emerges that the American people are paying about as much for electricity as for daily bread. As against an expenditure of $7 a year each for bread, there may now be put $1.50 per head for electrical apparatus, $3 a year for electrical transportation, $1.50 for electric light and power, 50 cents a year for telegraphy and 50 cents for telephony, with all the varied services of fire and police alarms, messenger calls, electro-therapy, electro-chemistry, electro-metallurgy, weather and time signals, telpherage, automobiles, etc., thrown in. A public that has reached the point of spending over $500,000,000 a year for electricity need not look far for an explanation of its rise to pre-eminence in the world's affairs.

It is a hackneyed saying that any electrician, to be worth his salt, must be nine-tenths a mechanical engineer; but when the quarter century began, ninety-nine one-hundredths of the practitioners knew nothing of mechanics. It had not been required of them. The mother art of telegraphy, with which they were all connected, based itself on a crowfoot battery and sheer manual dexterity. Oddly enough, while the old battery has gone, the telegraphic ideal is still the nimble finger and the supple wrist. Telegraphy is virtually the one electrical branch that remains founded on hand labor, and is to that extent unmechanical and unprogressive. The men most prominent in telegraphic management contend that "machine telegraphy" has not arrived, and that the business depends, as ever, on Bill Smith's ability to "pound brass." *Per contra*, it has been insisted by such intellectual leaders as the late Prof. Rowland, of Johns Hopkins University, and Prof. Pupin, of Columbia, that machine telegraphy is feasible; and their own significant efforts in the field have been supplemented by the eminently practical work of such men as Mr. C. L. Buckingham, to name but one other. Moreover, the Wheatstone printer, the Stearns duplex and the Edison "quad" all indicate the pathway of mechanical utilization and adjustment the ancient craft must follow, if telegrams are to be exchanged as freely as letters and telephone calls. And why should they not be? The American public sends only about two telegrams a year now, per capita, while it uses the telephone at least thirty times, and indulges in as many as sixty trolley trips; although the eldest service is fully as valuable intrinsically to the community as either of the other two.

Getting away, however, from telegraphy and telephony, the nine-tenths theory as to the make-up of the modern electrical engineer holds good. The census statistics show that 75 per cent. of the apparatus now produced is of a nature that was unavailable in the cruder days of the primary battery, and which would remain useless if trivial chemical changes within a glass jar were the sole source of current. The year 1900 saw an output of over 10,000 dynamos with a rated capacity of 770,000 horse-power. At an annual 20-per-cent. rate of increase that implies an output this year of not less than 1,000,000 horse-power capacity, all to be driven by mechanical means. This need not surprise anybody, for discussions as to 75,000 horse-power or 150,000 horse-power stations are becoming the commonplaces of chat when central-station men get together. The vital dependence of electricity on all the mechanical arts, and the close inter-relations of electrical and mechanical experience, have been established and emphasized to a notable degree these last twenty-five years, and the present century can but accentuate such conditions. The newer age may witness the production of electricity directly from fuel, but even then the raw material and the residue would have to be manipulated on a very grand scale. Meantime, the fortunes of economical current production are in close alliance with those of the latest steam turbines, in cities; and with the success of the biggest water turbines ever built, at all the great cataracts.

Indeed, among the highest benefits that

electricity has conferred of late is its conquest of waste water powers. Were it not for electricity, the position of water power, as compared with steam, would have receded far more than it has done. Steam has increased in thirty years from 51 per cent. of the power used in American manufacturing establishments to 77 per cent. The largest utilization of water power in the latter part of the period outside this, has been for electrical purposes, partly for manufacturing, but in considerable degree for other work. The increase in water power from 1890 to 1900 for manufacturing direct was about 464,000 horse-power, or about 50,000 horse-power a year. It is believed that the electrical development of water powers in the same period is far in excess of this, for lighting, for street cars, mining, etc. Every year has seen the equipment of great hydro-electric plants for places like Niagara, Rochester, Sault Ste. Marie, Sacramento, Salt Lake City, Ogden, Portland, Springfield, Mass., St. Paul, Richmond; while the minor plants have swarmed by their hundreds. In a great majority of cases, the water theretofore ran to waste, chiefly because its "white coal" was too far from market. Even to-day, similar powers linger in development only by reason of their remoteness; but when the energy of the Sierra Nevada streams can be sent over wire 220 miles to distant San Francisco with a loss of only 25 per cent., in quantities of thousands of horse-power, "remoteness" has become a relative term of little import. Achievements like this, and a few more coal strikes, will involve unexpected shiftings of industry and changes of motive power. Switzerland may yet be the manufacturing center of Europe, and Egypt, with an impounded Nile, the chosen home of cotton spinners.

Whether fed by current harking away from coal or by that from cascade, the electric motor has already come to its own in this quarter century. It has won out in two distinct and separate departments —driving axles and driving shafts. The observer who can watch the clean, bright, swift, quiet electrics on the New York Elevated and then prefer to be coal-dusted and begrimed by the puffing, asthmatic steam locomotives, does not belong in the twentieth century. When this journal was set going, not an electric road plied in the world. In 1890, out of 789 street railways in the United States, only 114 were electric. This year the score or two out of 1,200 which have not been electrified are "under condemnation" for early reform. This is, however, but a sketchy beginning. There is not a first-class steam railroad in the country that has not discussed the adoption of electric locomotives for some parts of its system or that is not already paralleled competitively by an electric line at some points. Even if it were not so, electric traction has for years to come all it can do filling up the chinks in between the trunk lines operated by steam. Rural regions once isolated, around such cities as Detroit, Cleveland, Cincinnati and Indianapolis, are gridironed with trolley tracks to every barn 'oor, and the farmer's wife "steps lively" to the unaccustomed music of the tingling car bell. The "hayseed" sells perchance less fodder, but the electro-machinist has opened up for him all that is best in city life and given him an infinitely larger market for all else he can grow. Now that the trolley has minimized the need for good country roads over which to haul his produce, the farmer will have more time and leisure to spend on making them better for his daughter's automobile.

The other use of electric motors is in "stationary" work, and here the quarter century has witnessed a striking revolution. It is a tenable proposition that one of the causes for dear beef is that electric motors have killed the demand for

THOMAS COMMERFORD MARTIN,
Past President American Inst. Electrical Engineers,
Editor *Electrical World and Engineer.*

belts. The average factory, or the ordinary machine shop, when the AMERICAN MACHINIST started, was a mazy and amazing aggregation of crooked line shaft and flapping leather. The improvement that has been made in power delivery from origin to tool or machine is nothing short of marvelous. Surely the most interesting feature lies in the adoption of the electric motor. If there is any new factory of any size or importance in this country in which electric power of some kind is not to be employed, the writer has still to hear of it. Yet the innovation is comparatively young and strange. The statistics of American manufacturing show that at the time of the last census, in 1900, electric power was not 5 per cent. of all that was in use in such plants, or about 500,000 horse-power out of a total of 11,300,000. But things are to be judged by tendencies rather than by the *status quo,* and these electric-motor figures exhibited an increase in the decade of nearly 1,900 per cent.! In New York city alone, one corporation selling current—the New York Edison Company—reported for 1900-1 a total of 50,634 horse-power of motors connected, or thirty times as much as in 1890. One of the corollaries of this advance, now accelerating, has been the association of the motor with the driven tool or machine. This may be pushed too far, but the advantageous limit is not yet in sight.

An aspect of electric evolution not strictly pertinent to mechanics at first glance is the growing use of current for electro-chemical processes. The list of various sign boards on the Niagara power reservation makes an excellent chemical directory. At the Falls nearly 40,000 horse-power produced electro-mechanically is now utilized electro-chemically and the end is not yet, for if 200,000 tons of copper are now refined electrolytically every year, it is hard to say where the metallurgical part of the business will stop. Be that as it may, let the practical contemplation of the correlation of forces rest on the picture of Niagara, harnessed by the American machinist to a water wheel, driving an electric generator, whose current furnishes arcs for Bradley to burn the nitrogen out of the ambient atmosphere and help feed peaceful mankind or blow the warlike part of it to smithereens.

Music and Smoke.

We learn from the *Musical Courier* of a curious idea of one John Peslin, of Chicago, for the suppression of smoke. Mr. Peslin explains his ideas in our contemporary as follows:

"Three notes in music form a chord which corresponds, analogically, with the natural phenomenon of combustion. Now, combustion is in itself a wonder, and would fill us with awe and astonishment if we were born in some region where it was unknown, and were suddenly to witness it for the first time.

"In presenting my analogy between music, or a musical chord, and combustion, I will call the lowest note of the chord carbon or fuel, the second air or oxygen, and the third and highest, temperature.

"Now, just as a discord would be caused by the substitution of a wrong note for any one of the correct three in the perfect or harmonious chord, so we would have incomplete combustion if more coal were introduced in our furnace fire than could be supplied with oxygen. Our lowest note, speaking by the analogy and in its terms, would be too low, and dense smoke would be the practical result. Why? Because a certain amount of air by weight is required for a given amount of either carbon or hydrocarbon.

"Furnaces as at present constructed are seldom perfect, for the simple reason that what I call a chord is seldom struck, except by accident." What next? Smoke symphonies!

FOUNDRY PROGRESS

By HARRIS TABOR.

The growth of the foundry trade—and by this is meant the general casting of metals—during the quarter century of the AMERICAN MACHINIST's existence is quite as remarkable as the history of that highly valued journal. The latter, starting with a meager monthly edition twenty-five years ago, has been closely identified with the problems and progress of the country. Always ready with its columns to give aid by discussion and otherwise, it has been a positive help in developing the wonderful resources and directing the genius and energies which have made this the leading industrial nation of the world.

It is difficult to outline the foundry methods—for they were about as numerous as the shops—of twenty-five years ago. At that time, system was comparatively unknown, and the chemist's knowledge was rarely brought into use. Buying pig iron by analysis was unknown; the fracture of the broken pig determined all—the laboratory, nothing. The results might be, and often were, as varied as the whims of the mixer. Since the first issue of this journal from the little office where we liked to congregate, an accidental mixture of unsalable irons helped to determine the value of silicon as a softener; and, within the same period, the chemist has largely reduced the dangers from phosphorus and sulphur, and has given mixtures which were beyond the reach of the old-time foundryman. When this journal was in the throes of "teething," the cutting speed of machine tools in cast iron was about 16 feet for the planer and a trifle faster for the lathe; to-day, twice that is common in the average machine shop, and in many cases the old speeds may be multiplied by three and four, and this with decidedly better machinery castings. This increase in cutting speeds is somewhat due to higher grades of tool steel, but the foundry has carried the big end of the burden.

The united efforts of the foundryman and the tool steel maker made the demand for the modern American heavy machine tools which are being copied all over the industrial world. The foundryman's mixture has been quite as influential as the machine tool designer has been in reducing machine shop costs.

The foundry is so closely allied to the machine shop as a feeder that progress in the latter means advancement in the former. The designer depends on the molder's skill, though credit is rarely given. If we take the steam engine, in the larger sizes, and compare it with the engine of twenty-five years ago, the wonderful advancement in the molder's art is apparent. Cylinders which in size and shape were then commercially impossible, on account of cost and lack of facilities, are now everyday occurrences. On your transatlantic trip, when you go below into the great ship's engineroom, it is safe to say that you take off your hat to the designer and builder of the ponderous machines giving out tens of thousands of horsepower, but you never bestow a thought on the molder who made the big cylinders possible.

In the old days it was often necessary to hold conferences with the foundry foreman to discuss methods of getting patterns out of the sand, and many of us have changed design with a view to keeping on good terms with the molder. Such things rarely happen now; the foundry adapts itself to the designer's lines; no matter how irregular the pattern may be or how seemingly difficult to mold, some way will be found to do it. I know it seems to be the general belief that we have not so large a percentage of good, all-around molders as we had a few years ago, but it is certainly easier than ever to get difficult castings made on a commercial basis.

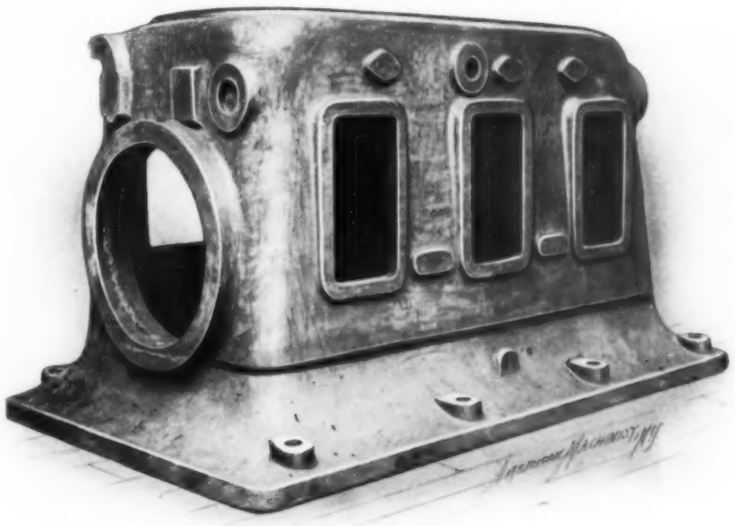
The success of the American foundry is due to several causes, all of which have largely developed since the birth of this journal. First among these is, probably, specialization—that is, adopting certain lines of casting for which each foundry is fitted, and holding to them. This is the origin of duplication and the piece-price system, and it is this, coupled with a disposition to adopt labor-saving methods, that has placed the American makers of light castings in advance of all competition. In hardware, agricultural machinery, stoves and ranges, water, steam and gas fittings, the American foundryman leads the world in quality, quantity and cost.

In the above named specialties, molding machines have been a most important economical factor, for without them success could not have been so rapidly attained. In addition to reducing the molding cost they have kept up and improved quality and uniformity; as they can be operated by comparatively unskilled help, they have made possible the phenomenal growth of these industries, in recent years, without serious embarrassment to the management. These machines have become as much a part of the modern foundry equipment as the crane. It may be said, in fact, that they bear the same relation to the foundry that the milling machine does to the machine shop; and as the limitations of the latter are determined by the ingenuity and resources of the toolmaker, so is the capacity of the former governed by the ability of the patternmaker. And the machine patternmaker is fast becoming as much of an expert as the toolmaker.

The molding machine is not now confined to small work, nor is extensive duplication of castings longer necessary to its success. The cost of making a mold has quite as much bearing on the case as the number of castings to be made. If a thousand castings from one pattern, or gate of patterns, be a day's work for one man, and six castings from another pattern represent the same amount of work, in time or cost; and if by substituting machine molding for hand molding the product from each pattern is increased 50 per cent., or the cost equally reduced, it follows that the larger pattern is quite as well suited to machine molding as the smaller. We might go farther and insist that a greater economy would be obtained by putting the larger pattern on the machine for the reason that it is probably more difficult to mold, and therefore a greater measure of skill gives way to lesser experience. The tendency of the modern molding machine is towards heavier work, and as the foundrymen learn its value, its use will be greatly enlarged. The increase in our foundry output has so much exceeded the growth in the ranks of skilled molders, that molding machines have become a necessity, independent of the saving secured by their use.

In the production of heavy castings, the American founders have not been laggards. While we have not so thoroughly dominated this field, we have advanced

rapidly and are fair rivals, in dry sand and loam molding, of our friends across the sea; and in substituting green sand for dry sand and loam it is probable that this country is in advance of all others. When the AMERICAN MACHINIST was in swaddling clothes, green sand molds for heavy castings were considered a "Yankee trick" by our English friends. It may be still considered so by them, but in this country it is marvelous how much the products of the oven and the bricked-up shapes have given way to skin-dried molds made in green sand. This method of molding has been with us a growth rather than an idea. No one man or shop originated it, but many have helped to develop and extend its use. It is probably the old story of necessity being the mother of so many good things. This system of skin drying is carried to the greatest extent in Pittsburgh and vicinity, where natural gas is so abundant. It is probable that the Westinghouse Machine Company leads in the size and number of molds so treated, and their success with this method is remarkable. Mr. P. C. Smith, superintendent of the Ingersoll-Sergeant Company's foundries, also makes large castings in surface-dried molds. He uses the Wells light for drying, turning the flame into the covered mold.



ENGINE BASE CAST IN GREEN SAND. WEIGHT, 21,700 POUNDS; 10 FEET 6 INCHES LONG, 6 FEET 6 INCHES WIDE, 5 FEET 11 INCHES HIGH.

MOLD FOR ABOVE CASTING OPEN AND WITH CORE IN PLACE AS MADE.

The accompanying photographs of a large Westinghouse engine crank case illustrate the extent to which skin drying is carried in this country. The open mold shows the method very clearly. It is surface dried by natural gas flame. I quote the following from Mr. W. A. Bole, general superintendent of the Westinghouse Machine Company: "The cost of molding, at the present rate of wages, is 58-100 cent per pound, which is a little higher than we like to admit, but the casting is of such a large size that we are compelled to take special pains and allow plenty of time to insure against carelessness in execution and consequent risk in losing casting."

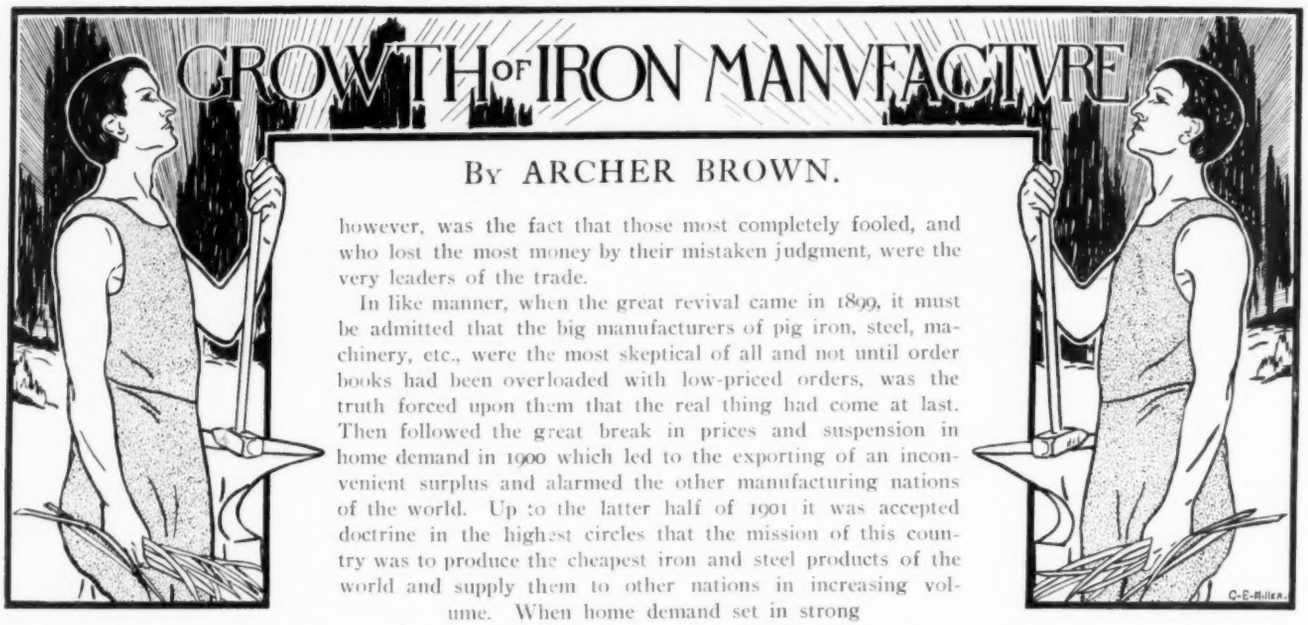
Foundry equipment generally has been vastly improved within the past twenty-five years. In the matter of cranes alone, hardly a trace of the old practice remains. The modern electric crane, traversing the foundry, and running its entire length at a speed of several hundred feet per minute, is the veriest slave of the molder. With it he can do the most delicate pattern drawing and can handle with ease and dispatch the heaviest castings. We have grown so accustomed to its prompt obedience to our demands that we do not fully realize its value.

In the cleaning room we find that improvements, in the way of pneumatic chippers and sand blast, are doing their share towards improving and cheapening the foundry's product.

But something more than a modern foundry plant, equipped with labor-saving appliances, is needed to develop and build up such a trade as our foundries control. That element is the human part of the plant. With bad management and indifferent workmen, improvements avail nothing. It needed a naval war to discover our "man behind the gun." In the industrial war for the trade of the world we shall find our artisans, more than all else, will prove the winning factor.

HARRIS TABOR,
Engineer.

If it be in order, Mr. Editor, permit me to tender my heartiest congratulations and best wishes on this the twenty-fifth anniversary of the AMERICAN MACHINIST.



By ARCHER BROWN.

First—Its Growth.—It is a noteworthy fact that no optimist has been bold enough to predict what has actually come to pass. The back-sets of the trade have been so many and so severe, and have left so deep an impress upon the minds of manufacturers, that it is not surprising that they should receive more consideration when forecasting the future than the more or less short-lived booms which have doubled up tonnage in incredibly short periods. Going no further back than the memorable boom of 1879-80, when pig iron sold at $60 a ton and every agency for increasing the production was set in motion, it will be recalled by those who were then engaged in the business that prudent manufacturers and merchants were united in the belief (after demand slackened and prices broke) that the thing had been grossly overdone, and that we should have to pay dearly for the folly of overproduction. And we did—in the years 1884 and 1885. That was when we were producing two or three million tons per annum. If anyone had been bold enough to predict at that time that within two decades our furnaces would be making eighteen millions of tons and that this would fall a million tons short of the actual requirements of the country, he would have been counted a lunatic. Nothing is better understood by those who have been long in iron making than the very fallible character of the judgment of those of largest experience and foremost standing in the trade. There was a notable proof in the summer of 1895. Something started an active demand for iron, and it was interpreted by no less sagacious observers than the officials of the Carnegie Company as the commencement of the real revival that all knew would some time follow the disastrous panic of 1893. Prices of pig iron rose 40 or 50 per cent. It proved a soda-water rise. The country was not ready for the real revival which came four years later. The noteworthy thing about it, however, was the fact that those most completely fooled, and who lost the most money by their mistaken judgment, were the very leaders of the trade.

In like manner, when the great revival came in 1899, it must be admitted that the big manufacturers of pig iron, steel, machinery, etc., were the most skeptical of all and not until order books had been overloaded with low-priced orders, was the truth forced upon them that the real thing had come at last. Then followed the great break in prices and suspension in home demand in 1900 which led to the exporting of an inconvenient surplus and alarmed the other manufacturing nations of the world. Up to the latter half of 1901 it was accepted doctrine in the highest circles that the mission of this country was to produce the cheapest iron and steel products of the world and supply them to other nations in increasing volume. When home demand set in strong in the fall and winter of 1901-2, furnaces and mills rather eagerly filled up their order books at slightly improved figures on the theory, almost universally accepted, that the improvement could not last more than six months or a year. Now a year has passed, prices are up 40 to 60 per cent. more, and makers are plodding along wearily on the old contracts, with costs rapidly advancing through the rise in wages, transportation, fuel, etc.

The points I desire to emphasize from the above are: 1. That the foremost manufacturers and leaders in the trade have seldom, if ever, shown signs of appreciation of the sure and rapid development of the country and the immense expansion of the iron industry that was ahead. 2. That the reactions following periods of prosperity leave more lasting impressions than the booms and have a more powerful influence in molding the policy of manufacturers. 3. (Suggestively.) If the future is in any measure to carry on the record of growth in the past, where is the prophet who will dare to predict in figures the results twenty years hence?

Second—Obstacles to Progress.—These we are encountering just now to an embarrassing degree. It is found that transportation facilities have not kept growth with the development of iron and steel. There are not cars and engines enough to handle the rapidly increasing traffic. Furnaces are banked because coke lying in yards at the ovens cannot be transported to where it is needed. Great as the Lake Superior ore movement is, this year, surpassing by several millions of tons all previous records, yet it is gravely questioned whether a sufficient quantity can be got down before the close of navigation to fully supply the needs of furnaces for the winter. Coal mines have not been opened nor coke ovens built fast enough to meet the increased demand for fuel. Labor would be in adequate supply if there were no interruptions by disputes and no restriction of output through discontent. But, as wages are raised, the units of product per man are decreased. In some districts, notably in the South, where negro labor predominates, miners find they can make enough to live by working only two or three full days in a week, and it is found impracticable to induce them to work more. So it proves in more than one instance that pressure for increased output results actually in a decrease with steadily enhancing cost.

And so the question is often heard in these piping days of prosperity whether there is not such a thing as too much of a good thing; whether increasing costs are not going to throw us out of the markets of the world, where our high-priced labor must come in competition with the products of cheaper European labor; whether the strain upon the mechanical resources of the country and the nervous resources of our business men is not too great for our good; whether, in short, prosperity prospers as much as we think it does. Certain it is that the conditions of 1900, when we were scaring German and English ironmasters so badly, are completely reversed, and their products are now laid down at our doors at prices under our home markets, and in some instances below our home cost of production. And this notwithstanding tariff schedules which by many are deemed too high.

Third—Our Raw Materials.—The permanent strength of the American iron manufactures lies of course in our great natural resources in coking coals and iron ores, coupled with facilities for assembling these materials by water and rail at a lower cost than furnaces and mills enjoy in any other country of the world. In a recent review (*Engineering Magazine*, October, 1902) I undertook in some detail to inquire into these foundations of the industry. Suffice it to say here that while certain well-known fields have their limitations already clearly fixed, other dis-

tricts, but yet partially developed, hold immense reserves, which preclude the possibility of our furnaces lacking cheap raw materials for generations to come, no matter how rapid the growth in product. The Connellsville coke district will soon reach its maximum output and then slowly decline. But there are large reserves in the adjacent district south and west, not yet fully developed by the railroads. It is, however, in the section where Virginia, Tennessee, Kentucky and West Virginia meet that the great future supply of coking coal is found. And that territory is now being rapidly opened up and will, in the not far distant future, become as large a shipper as the Connellsville field.

In the Lake Superior ore district, the sources of supply that were most counted upon ten years ago—the so-called Old Range ores—have reached their limitations, and, unless new and unexpected development occurs, will henceforth be declining factors. But the great Misaba range, which has been extensively explored in the past three years, and which has become the largest shipper of all, has very great possibilities. This sets forward for an indefinite time the period of exhaustion of the raw material which is now the foundation of the great steel-making industries of Pittsburgh and the Great Lakes.

Generally speaking, the outlook for the iron and steel industry of the United States is big with promise, provided only that labor is willing to resist the ill-counseled demands that will be made upon it to restrict output or to push the advance in wages too far above the parity of other nations.

An English Analysis of American Census Figures on the Iron and Steel Industries.

Some very valuable and wholesome lessons are to be learned from the figures recently published by the United States Census Office as to the iron and steel industries of that country. The most important of these lessons is the great improvement in the capacity and work of the men employed in the industry in question between 1890 and 1900. On analyzing the census returns many curious and striking facts are elicited, and we cannot but think it to be well worth while of our manufacturers to scan them very closely, with a view to drawing from them such information as can be compared with the data as to British practice which every manufacturer has, or ought to have, at his disposal. Let us take only three sets of figures as examples of the kind of information we refer to. A little sum in arithmetic enables us to learn that in the interval between the two census years 1890 and 1900, the average annual value of the manufactured products of American iron and steel works, per workman employed, increased from $2,800 to $3,621, or about 30 per cent. This, of course, is a great gain, but the question arises—at what cost was it purchased? If wages or other costs had to be increased in a corresponding degree the actual gain might conceivably be reduced to zero. It therefore becomes important to examine the statistics of wages, and on doing so we find that the average wages paid per worker employed increased from $521 in 1890 to $544 in 1900. In other words, with a gain of only $23 in wages, the individual workman has been enabled to add $821 annually to the average value of his work. This, again, may conceivably have been wholly a function of increased price, in which case the individual workman would not have rendered any larger economic result, but on analyzing the statistics of output, it transpires that the average in 1900 was 132 tons per worker, against only 95 tons in 1890, which is a gain of about 40 per cent. Another way of estimating the true economic difference is to compute the value of the products obtained in relation to the amount expended in wages. This process fully confirms the advance indicated by the previous figures. In 1890, each dollar expended in wages returned $5.3 as the value of the products which these wages were employed to produce, but in 1900 the value of products per dollar of wages had increased to $6.6, being an increase of over 26 per cent.

ARCHER BROWN,
Iron merchant.

It is a common belief that the cheapening of the cost of production in the United States during recent years, and the consequently low figures at which the great iron and steel plants in that country can now manufacture, are mainly due to the lower cost of raw materials and to the great reductions that have been made in the cost of transport. The figures which we have just presented prove conclusively that although these have been not unimportant elements in the general result, the greater efficiency of labor has been no less potent and important, and that this greater efficiency has coincided with a material improvement in the rate of wages paid, the average of which, in 1900, including all ranks, classes, localities and ages, was about £110 per annum. Whether this result has been due to greater individual effort on the part of the workers, or to the greater automatic efficiency and economy of the appliances provided for his use, is a matter of minor concern; the important fact is that the unit of labor produces a greater value than formerly. It is possible that if this improvement had been almost entirely due to newer and better mechanical appliances and processes, it would have been accompanied by such a great swelling of the capital account that what was gained in one direction might be lost in another. But the available figures go to show that nothing of the kind has happened, and that the return on the capital embarked in the American iron and steel industry, in terms of units of value of product per unit of capital employed, has considerably improved over the period in question. Put in more precise form, the average value of product per dollar employed as capital was $1.1 in 1890 and $1.4 in 1900. It is quite apparent therefore that the vast increase in capital outlay incurred on behalf of the American iron industry during recent years has been justified by results. The increased outlay between the years 1890 and 1900 is shown by the census figures to have been about 400,000,000 sterling, but this, we fancy, does not include betterments made out of current revenue. At any rate, it is certain that during the years 1901-1902 alone, the additional outlay incurred on behalf of new and improved plant cannot have been much less than the figures given for the whole previous ten years. Much of the economy that has been achieved in American iron and steel works during the last few years is, no doubt, a result of the larger average scale on which manufacturing operations are carried on. The available figures as to this matter are not so complete as they might be. It would have been interesting and instructive had the census provided a graduated statement of the capital embarked, showing, say, the number of concerns severally over and under a million dollars of capital. As it is, we are only able to discern that, while the average capital per establishment was returned at $570,000 in 1890, it had in 1900 risen to $880,000, which is an increase of over 50 per cent.—*Iron and Coal Trades Review.*

Some of those in English cities who object to contracts for machinery going abroad when the municipality is the purchaser are making use of the British workman and claiming that money paid by him should not be used to employ men living elsewhere when he is qualified to do the work himself. This is a very taking argument, but it will not stand inspection. Carried to its logical conclusion, each city would make everything used in it.

A QVARTER-CENTVRY'S PROGRESS IN MACHINE TOOLS

In this article we propose to show by illustrations and text as nearly as we can the advance that has been made in the designing of the leading machine tools as built and used in American machine shops during the twenty-five years since the AMERICAN MACHINIST has been, as occasion offered, giving illustrated accounts of examples of improved tools.

For obvious reasons it would be impracticable for us to take up in this article all the tools built twenty-five years ago and all those built now; and we have thought best to limit this showing to those tool-building establishments that have been in business during the entire period; or practically so. Furthermore, we have limited it to a certain line of tools which are thought to be fairly representative of all, leaving out tools that have been originated since 1877, or that are more special in their nature than those presented. We invited every concern we know of that had been in business during the entire twenty-five-year period to participate in this showing, and though most of them responded and furnished us with the necessary photographs or prints and data, some failed to do so from various causes.

Again it is not so easy as might be imagined to find prints or photographs of tools made twenty-five years ago. Things move pretty rapidly these days, and printed matter, circulars, catalogs, and especially photographs are in some cases difficult to get hold of.

Nevertheless the illustrations we have been able to prepare constitute, we think, a very satisfactory showing.

First, we take up the tool which is perhaps more common than any other and to which the apprentice boy is most apt to be first introduced—the drill press, which, in our opinion, might better be called the driller because it drills, for the same reason that the planing machine is almost universally called the planer because it planes.

It is not possible to go into particulars very much regarding the differences between these older and newer machines, nor is it necessary. The photographs tell most of the story, and in most cases tell more of it and tell it better than would be possible in words.

BARNES UPRIGHT DRILL.

The illustrations show the 25-inch driller built by the W. F. & John Barnes Company, of Rockford, Ill., and it will be noticed that the old and new machines are, in general design, very much alike. The new one is, however, equipped with back gears (which are carried inside the cone); the feed is driven by means of cone pulleys instead of by cam and rocker as in the earlier model, and a step is now provided which throws out the feed when the hole is drilled to the proper depth.

BEMENT, MILES & CO.

We illustrate the 36-inch drill of 1877 and the 40-inch machine as now made. The machines differ, principally, in the design of base, column and table, and in the arrangement of the driving gear and feeding mechanism. The later drill has an extended base with working surface, a round column about which the table may be swung, a circular table (with oil channel) which may be rotated on its axis, and table-elevating screw operated by means of a crank at the side of the column. A taper pin is provided for locating the table central with the spindle, so that a boring bar may be used; and the arrangement throughout for supporting the work and locating it under the drill is here much more convenient than in the earlier machine. The countershaft, shown at the foot of the old drill is not embodied in the new design, the cone being driven, instead, from a countershaft overhead. The 40 inch machine, which, it will be observed, is provided with back gears, has, in addition to the hand feed through handwheel and protected worm gearing, and rapid hand movement of the spindle by means of the lever at the left of the head, a power feed, driven, as shown, through the three-step cones.

GOULD & EBERHARDT DRILLER.

The new machine differs from the older not only in the general design of base, column, head, etc., but also in the driving and feeding mechanism, the arrangement of the table and the manner in which it is elevated, and in many other particulars clearly indicated. The new machine is much more rigidly constructed and more convenient in operation; it has a greater number of speeds, and instead of the handwheel feed with which the older machine was provided, has both power and hand feeds, the spindle feeding through the head or the latter moving up and down on the column, as desired. The feed is independent of the spindle—having a driving cone of its own—and a coarse feed for reaming or finishing can be instantly obtained without stopping the machine. The feeding mechanism is so arranged that when the back gears are thrown in, the feed is increased ten-fold. A stop throws out the feed at the required point. The head is fitted with an automatic tapping attachment for small work; heavy tapping is done by the main spindle; the friction pulleys on the driving shaft having forward and reverse belts. The machine has a compound table, and an oil pan is formed at the base, oil pump and piping being provided.

NEW HAVEN MACHINE COMPANY.

The photographs show at a glance the principal points of difference in design, the older driller exhibiting in its fluted column an example of the now-passed-away architectural style of machine design. The back gears on the new machine can be thrown in from the floor; the lower arm is moved upon the column by a screw, the spindle is counterbalanced and the brace at the back is carried down to the base, so that the stiffness of the machine and the alinement of the spindle when doing heavy work do not depend solely upon the rigidity of the column. The lower cone pulley is placed near the floor for the sake of the longer belt.

THE PRATT & WHITNEY COMPANY.

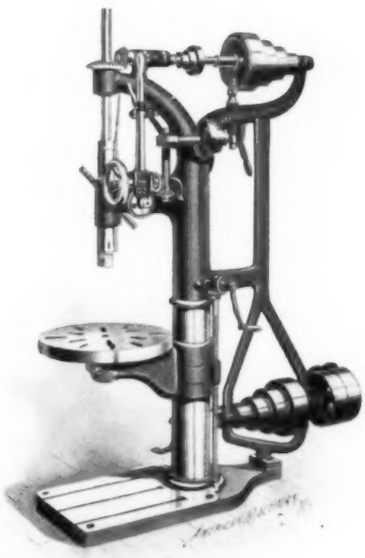
The Pratt & Whitney Company make a variety of drilling machines, and among these chose the gang drill as their representative of driller progress. It is a manufacturing tool rather than a machine-shop tool, and though the one of 1877 was considered in its day wonderfully efficient, the contrast between the older and the newer ones as we know them is very striking. As now built it is a heavier and more powerful machine. The spindles, originally driven by belts from the vertical shaft at the back, are, in the new model, driven by a Renold chain. The drill is furnished either with or without power feed, an automatic knock-off being provided when power feed is ordered. The work table is different from that fitted to the old machine and the counterbalance for the table is now placed inside the column. The new driller is made in three sizes, the one illustrated having six spindles. Twenty-five years ago the machine was made with either three or four spindles.

WM. SELLERS & CO.

This double-geared machine, as now constructed, while in general outline much like the Sellers drill of 1877, is heavier and more powerful than the machine of that period; and as the base—which is larger than in the earlier model—is planed off and provided with T-slots, large work can now be handled much more readily than in the older machine.

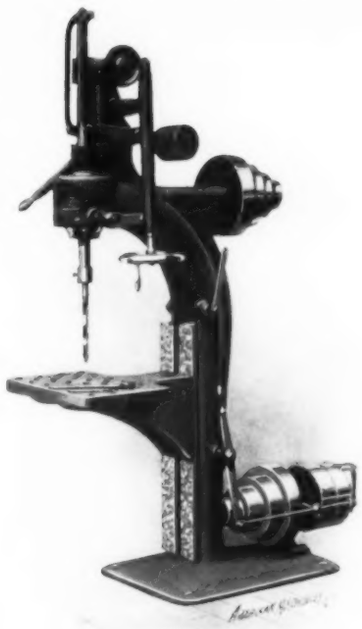
NILES TOOL WORKS.

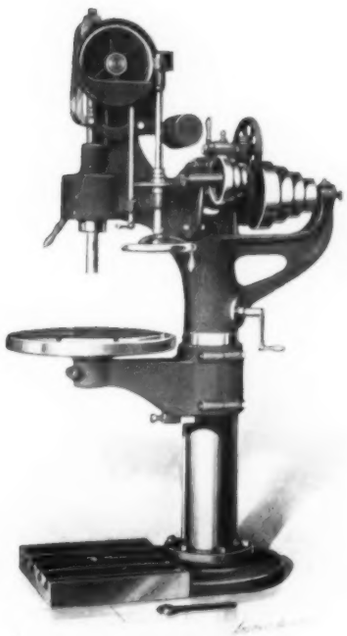
The 40-inch vertical machine of the late 70's, with the machine of the same nominal capacity as now made, is shown. It will be seen that the style of the machine has been changed entirely. The older machine was evidently intended to do a class of work which is now done to better advantage on other tools. The later machine has a shorter travel of the spindle, and is designed only for drilling, but for doing this more efficiently. The gears are manifestly much heavier, the spindle much more powerfully driven and with a much stronger feed. In place of the round table is a square one movable to and from the column, and with T-slots for the convenient attachment of work or fixtures.



W. F. & JOHN BARNES COMPANY.

The later radial drill differs from the older one mainly in being motor driven by a motor which is placed upon a vertical shaft at the top of the column; in having an arm which swivels to any angle, and in the form of the sole plate which is obviously much better adapted to a variety of work. In both these machines the entire column and all attached to it turn upon a stump over which the column is fitted and is clamped to the sole plate by the bolts and nuts shown in the flange. In the new machine the vertical shaft at the side of the column is driven by two ratios of gearing and from this shaft eight different speeds are obtained by the cone pulleys and back gears, making sixteen speeds in all.

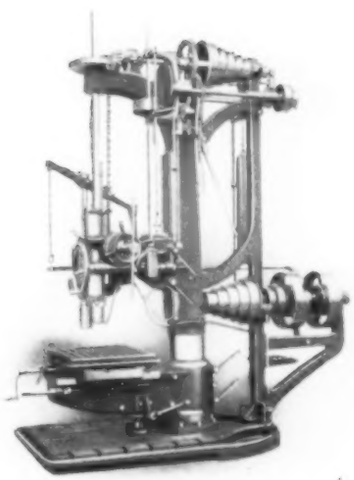




BEMENT, MILES & CO.

THE LATHE.

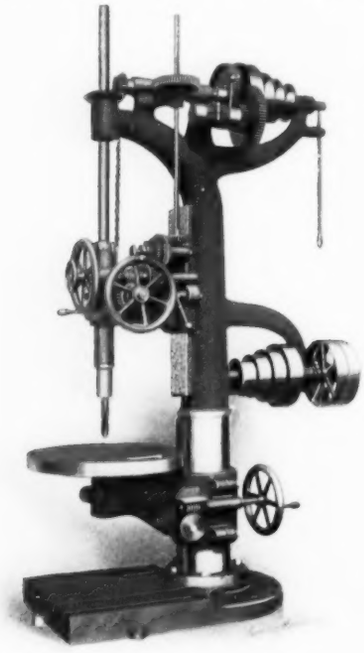
The lathe has been called the king of machine tools, and it well deserves the title. If a machine shop is to have only one tool in it, then that tool should always be a lathe. With a good lathe, skill to make it do all that it is capable of, and with this, skill at the vise and bench, almost anything in the way of machine construction can be done within the capacity of the lathe, and lathes are built in the most astonishing variety of capacities, from the delicate bench lathe used on watch work or on watch tools, which can be put in one's coat pocket, to the most ponderous machines used in turning and boring guns and weighing, in some cases, nearly 300 tons. Taking up the lathes of the different makers in their alphabetical order, it happens that the first to be shown are those of a firm which has long been a builder of very heavy lathes, and some of the examples given show in a very interesting way the improvement made in such lathes during the period under consideration.

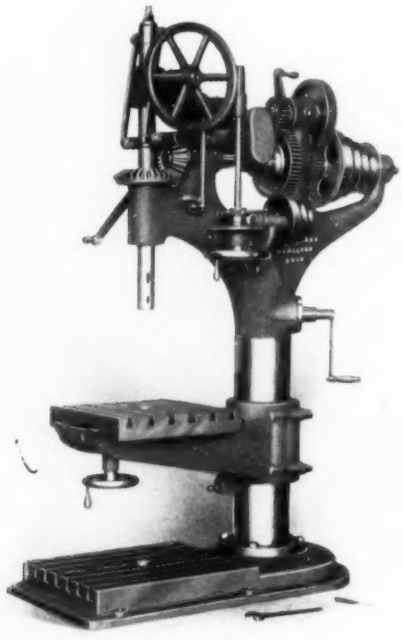


GOULD & EBERHARDT.

BEMENT, MILES & CO.

We take as an example their 100-inch crankshaft lathe, which, as built to-day, is far more massive, has much greater driving power and a wider range of speeds and feeds than the corresponding machine of 1877. The reader will note the change in the design of the head and the arrangement of the driving gear; the increased thickness of the face-plate, and the chuck jaws with which it is provided; the guarding of the driving and change gears, and the brake for stopping the lathe quickly or at a determined point. The carriages, also, it will be noted, are entirely different in design from the one on the older lathe, the feed gearing also being changed, and each is entirely independent of the other in all its motions, a change gear table being placed on each carriage apron. Each carriage is now provided with double compound tool slides, and these are much heavier and better supported than in the earlier design.





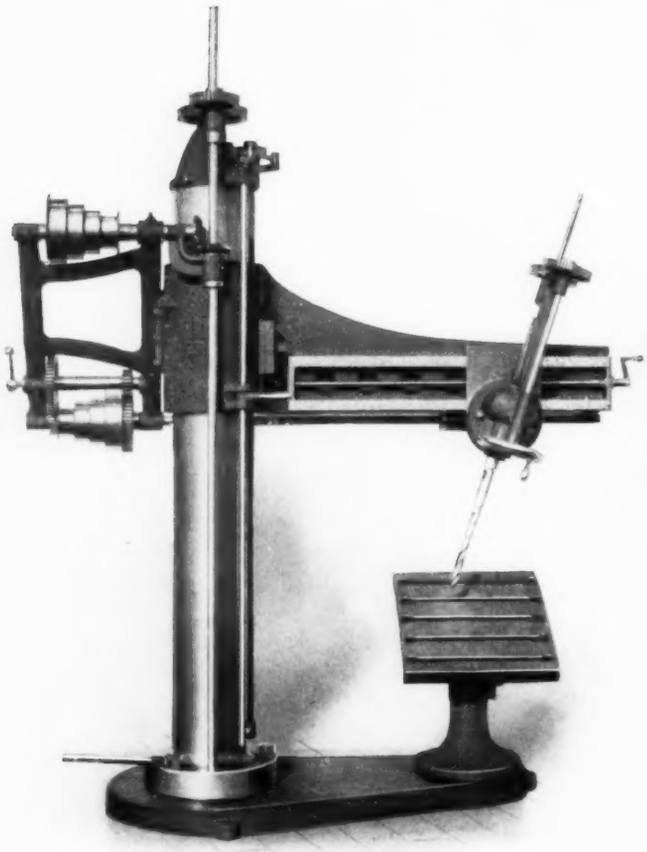
NILES TOOL WORKS.

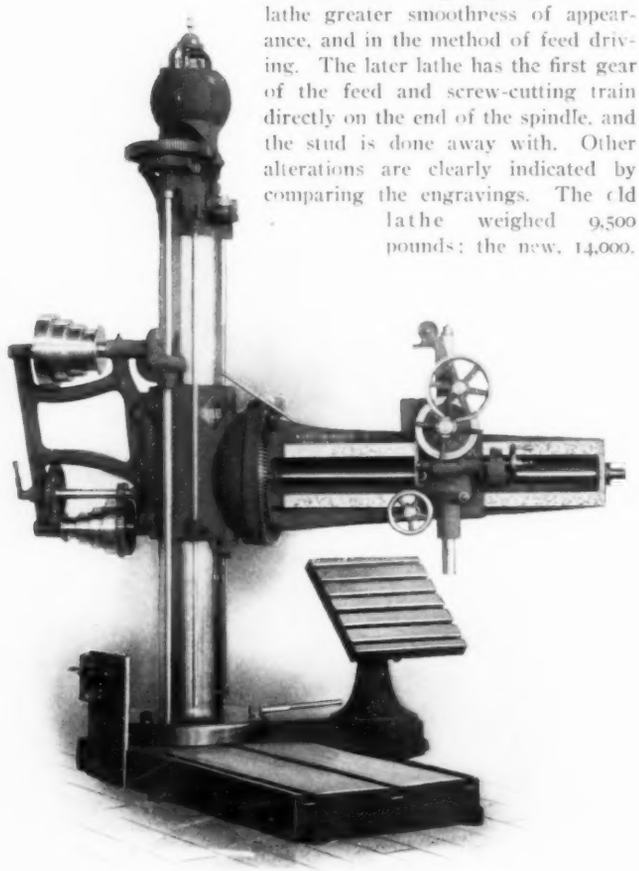
FLATHER & CO.

The new lathe built by Flather & Co. is, of course, much heavier than the old, the rigidity of the bed and strength of all the working parts being increased. The new lathe has a five-step cone, and the old-style feed cones being replaced by the device shown under the head, the carriage has a greater range of feeds for either turning or screw cutting and the feed is more readily changed. The headstock and tail-tock, which formerly rested on two "V's," in the new design rest on a "V" at the back and a flat way in front, this arrangement admitting of deeper and stiffer cross bridge for the carriage. A taper attachment is provided, and the carriage, which is gibbed inside and out, is provided with either plain or compound rest.

NEW HAVEN MACHINE COMPANY.

The most important changes that have been made are in the elimination of the sharp corners and "ornamental" features of the older design, giving the new lathe greater smoothness of appearance, and in the method of feed driving. The later lathe has the first gear of the feed and screw-cutting train directly on the end of the spindle, and the stud is done away with. Other alterations are clearly indicated by comparing the engravings. The old lathe weighed 9,500 pounds; the new, 14,000.

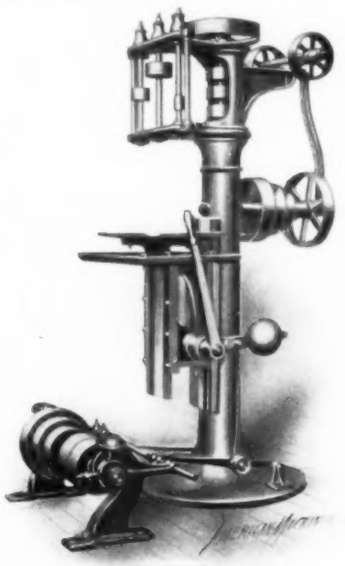




NILES TOOL WORKS.

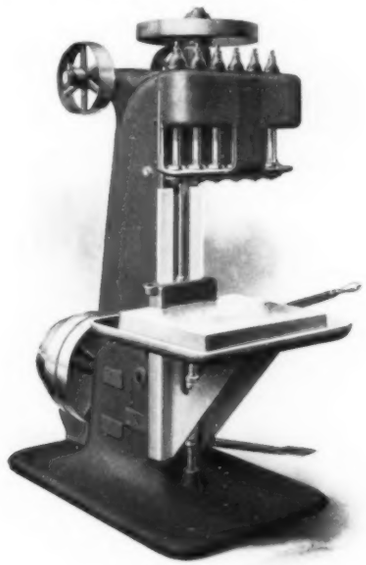
NILES TOOL WORKS.

The 38-inch lathe of the later 70's is shown, together with the "forge" lathe of the same nominal capacity, as now made. The latter lathe is triple geared, face-plate driven, legless and very much heavier throughout. By a push-and-pull pin in the stud of the present lathe various rates of motion are given to the gear train and the gears in the train may be of course changed for further ranges of feed or for screw cutting.



POND MACHINE TOOL COMPANY.

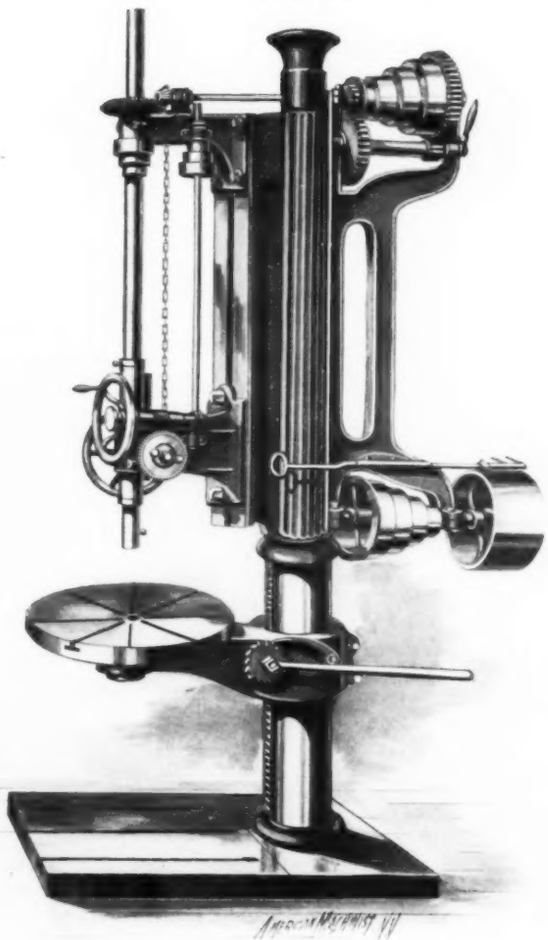
The Pond lathe, as made to-day, differs from the older machine principally in having greater driving power, a heavier and more rigid construction throughout, a wider range of speeds and feeds and a more convenient arrangement of handles and levers for controlling the longitudinal and cross-feeds. The carriage of the new lathe has a much longer bearing on the ways, and the bed is wider than in the older model, this increased width of bed allowing the tool slide to be well supported even when work of the largest diameter within the capacity of the machine is being turned. The back gears of the later machine, it will be noticed, are carried at the front of the headstock and provided with guards; and the footstock, as now arranged, is moved along the bed by means of a pinion which meshes with the feed rack, this pinion being operated by the crank shown in front.

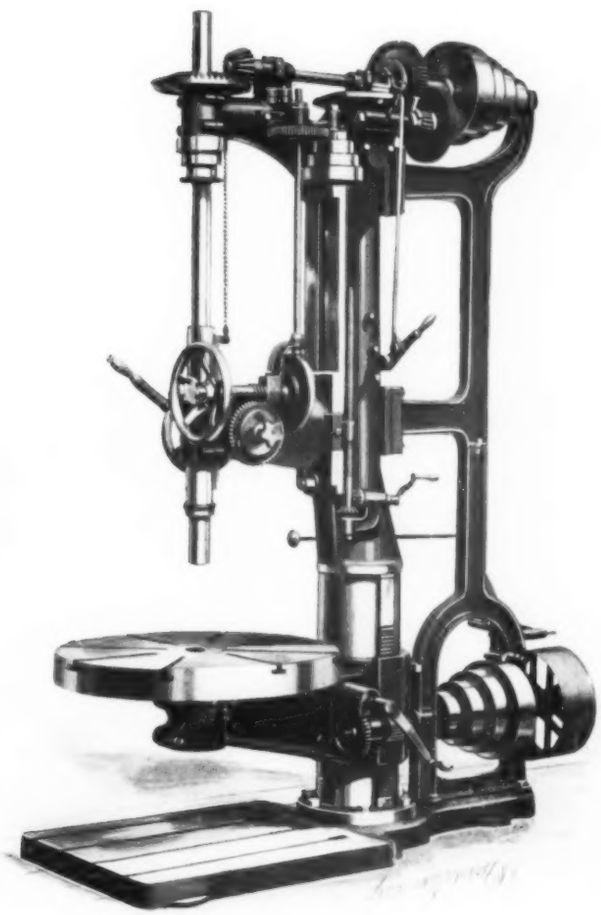


THE PRATT & WHITNEY COMPANY.

The illustrations show the 16-inch lathe as made by this company twenty-five years ago, and their 14-inch lathe as made to-day; the latter tool has practically the same swing as the 16-inch machine. The new lathe differs from the old in heavier design throughout; in the form of the ways—the headstock, footstock and carriage each resting on one V and one flat way instead of on two

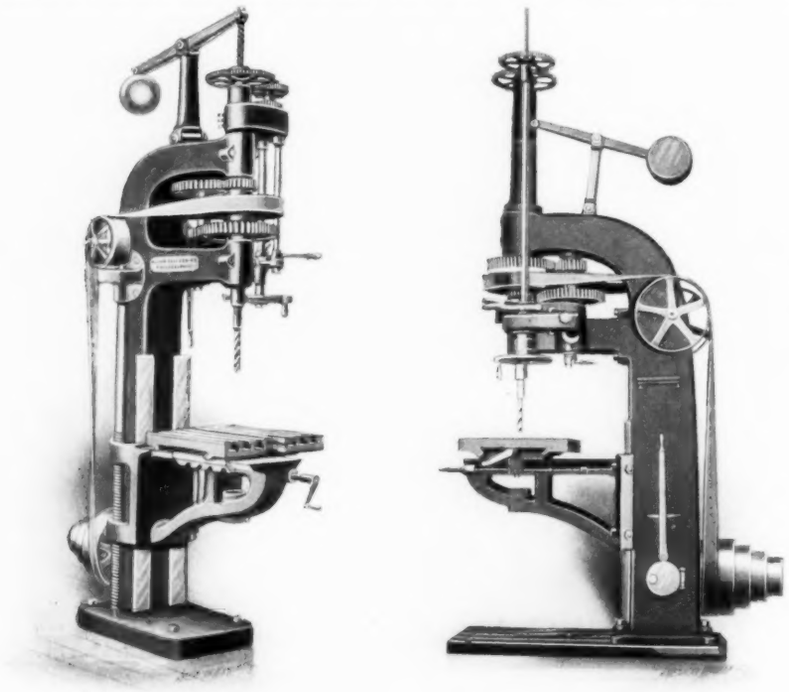
PRATT & WHITNEY COMPANY.





NEW HAVEN MANUFACTURING COMPANY.

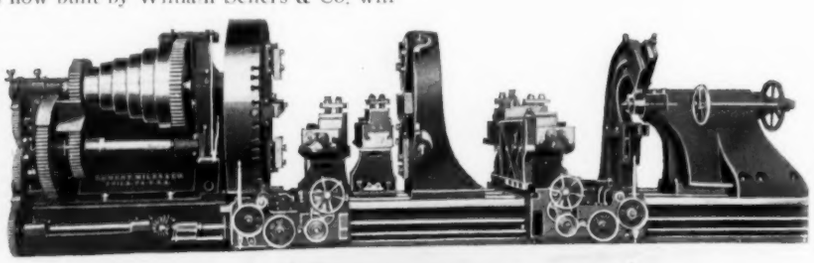
V's, as formerly; in the design of the headstock, which carries a larger spindle than was formerly used, this spindle now being made with a large hole clear through it, and being provided with a five-step cone; and in the construction of the carriage and the feeding mechanism. The feed is more easily changed in this lathe, and stops are provided for releasing the feed at any desired point. Threads from 2 to 96 per inch may be cut, while the older lathe cut only from 3 to 48 threads per inch. The new lathe has a compound rest, the footstock being so designed that the rest may be swung around parallel to the bed. It will be noticed that all unnecessary finish is avoided in making this tool, and that provision is made for taking care of gears, wrenches, etc. It weighs with taper attachment 2,200 pounds, the older lathe weighing but 1,200 pounds.



WILLIAM SELLERS & CO.

WILLIAM SELLERS & CO.

A comparison of the engravings which illustrate the earlier model 36-inch triple-geared engine and the corresponding lathe as now built by William Sellers & Co. will show that in the past twenty-five years very few changes have been necessary in the design of this tool. The new machine differs from the old principally in the increased strength of bed and other members, and in greater driving power. The outer edges of the shear which were formerly planed at an angle inclining inward from the shear face are now made perpendicular, and this we believe to be better than the angular form. The arrangement of the gearing at the apron is somewhat different from that provided on the older machine, and the feed-controlling devices are more conveniently placed. The cutting tool is better supported and clamped more firmly in the later lathe; and the footstock spindle, which in the older tool was clamped at the forward end only, is now secured at each end by moving a single lever; this being, so far as we know, the only lathe in which the tail spindle is so held.



BEMENT, MILES & CO.

PLANERS.

Though the planer is of course much older than the AMERICAN MACHINIST, it is not nearly so old as the driller and the lathe, and men are now living who can remember when it was quite the regular thing to produce flat surfaces by the laborious process of chipping and filing. Though a few planers were built twenty-five years ago that resemble present-day patterns, most of them were far inferior to the twentieth century machine. We show first the older and the latest

BEMENT, MILES & CO.

The new planer is provided, as shown, with motor drive, and the driving shaft is placed crosswise of the bed; with the regular drive this shaft is parallel with the bed, as in the older machine illustrated. Aside from this change in the drive, the new machine differs from the old, principally, in the increased depth of bed and platen, the increased rigidity of housing, in greater driving power, and in the quicker return for the table. Some changes have been made, also, in the arrangement of the belt shifter and in the feeding mechanism for the heads. Both side heads on the new planer are counterbalanced; all heads have automatic tool-lifters; the ways for

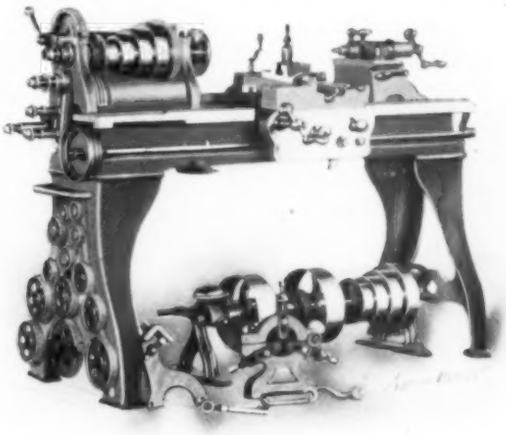
the table, while shown V-shaped, may be either "V" or flat; and the bed in either case is provided with oil pockets and rollers, so that perfect lubrication is practically insured.

BETTS MACHINE COMPANY.

The later planer differs from the older in having uprights of hollow section without ribs or projections of any kind. It uses four tools instead of only one, has of course far greater driving power, improved feed mechanism and a counterbalanced cross-rail with power movement.

HENDEY MACHINE COMPANY.

The new planer, which is built especially for toolroom service by this company, differs from the older machine in a number of ways clearly indicated by the illustration. The bed, housing and other parts are much heavier in the new machine; the mechanism for reversing the platen is arranged in a different manner, shifting driving belts being employed instead of the friction reverse used on the older planer; both elevating screws for the cross-rail are made right-hand, where formerly one screw was right and the other left hand. The vertical feed as now arranged reads to thousandths. It will be noticed that the feed rack has been done away with and a vertical shaft substituted, this shaft being actuated by suitable gearing at the bottom. The weight of the new planer is 2,560 pounds, the old one weighing 2,600 pounds.



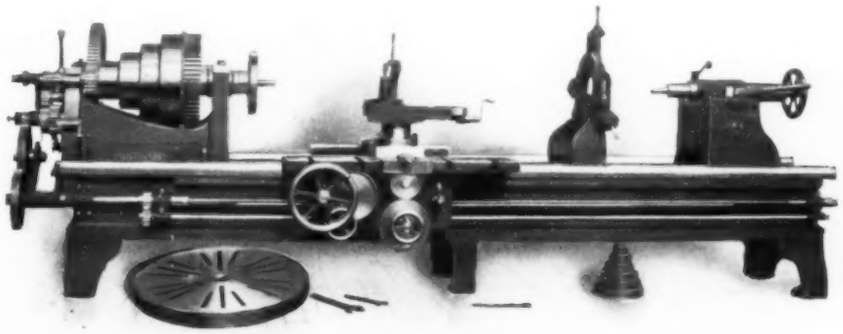
FLATHER & CO.

NEW HAVEN MACHINE COMPANY.

Functionally these two planers do not differ materially. They are both of medium size—too small to employ more than one saddle and are for the same work, which they do in the same manner. The difference is to be found chiefly in the shape of the uprights and in the general design, the later planer showing very plainly the influence of modern ideas.

NILES TOOL WORKS.

The 44-inch machines representing the practice of 1877 and the present day are shown and the main points of improvement are clearly indicated. The later machine has saddles on the uprights in addition to those on the cross-rail, has a much deeper bed and is much more powerfully driven. Both are worm driven.

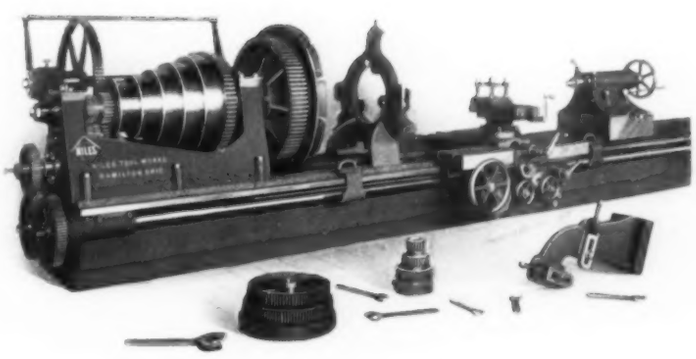


POND MACHINE TOOL COMPANY.

The illustrations show clearly the chief points of difference between the old and new Pond planers. The new machine has a more powerful drive than the old, and is much stiffer, it having a deeper bed and housing, a heavier platen and deeper cross-rail. The feeding mechanism for the two heads on the cross-rail of the new planer is entirely different from that on the older machine; both feeds are clearly shown and require no description. The changes made in the construction of the heads, the arrangement of the gears for the elevating screws and the running mechanism are also plainly indicated in the illustration.

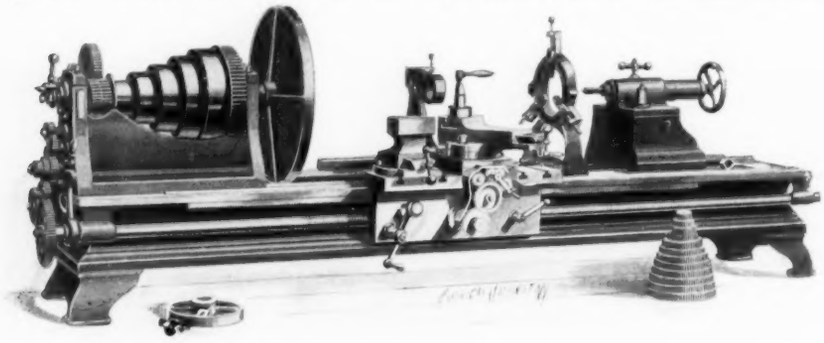
PRATT & WHITNEY COMPANY.

The planer as now made by this company has a somewhat larger bed and heavier upright than the older machine, and has automatic feeds in all directions, the old-style planer having automatic cross-feed only. Both forward and backing belts were on the same side of the machine in the old design, while now the driving belt is on the working side and the reversing belt on the back side of the planer.



NILES TOOL WORKS.

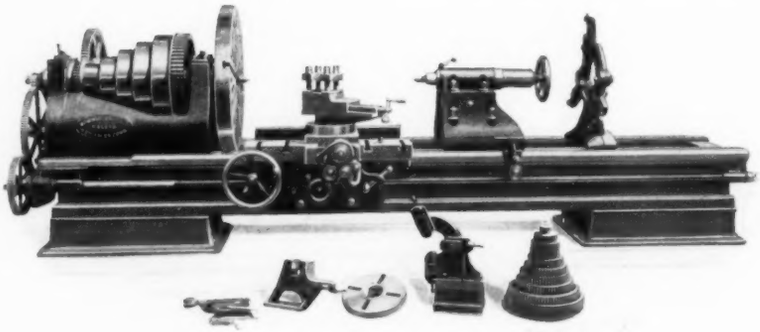
Some changes have also been made in the shipping movement and in the movable dog, which allows the work to be run either way from the tool without changing the stops at the side of the platen. The weight of the older machine with countershaft was 1,650 pounds; the new planer weighs with countershaft 2,150 pounds.



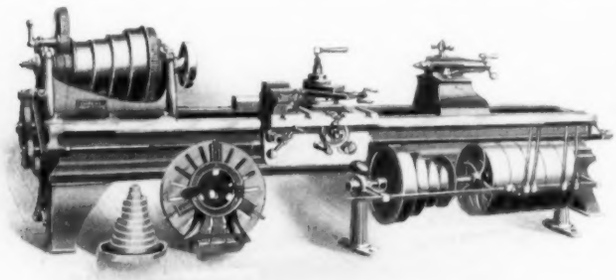
WILLIAM SELLERS & CO.

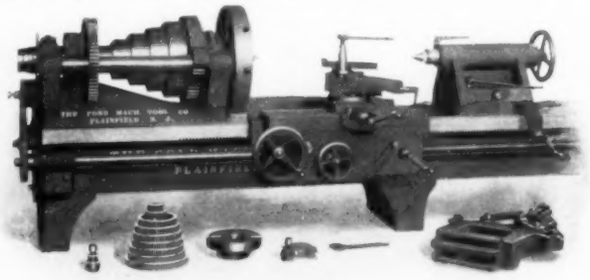
The heavy planer with spiral gear driving motion built by William Sellers & Co., twenty-five years ago, and one of the heavy spiral-geared machines built by them to-day, are clearly shown in the half-tones. The new machine differs from the old in a number of particulars. It has, instead of the open and crossed, shifting, driving belts, shown on the older planer, one belt only, which is not shifted, the reversing of the table being accomplished by means of a friction clutch. This plan of reversing was adopted in connection with a very high return speed for the table, and as a result of finding that at such high speeds it was the inertia and momentum of the rapidly moving pulleys and not of the platen that gave trouble. The cross-rail, like the rest of the machine, is made heavier and the two saddles with which it is provided are fitted inside the rail, the saddle of the earlier planer fitting over the cross-rail, as shown. The table, instead of traveling on two V's, as in the earlier design, runs on one flat way and one V, and vertical surfaces are provided for preventing displacement in case of extraordinary side thrust.

The feeding mechanism for the tools on the new planer, it will be seen, differs somewhat from that used on the older machine. The cross-rail elevating screws placed at the outside of the uprights in the older planer are now placed inside; the cross-rail is elevated by power, and the vertical tool slides carried on the uprights are counterbalanced.

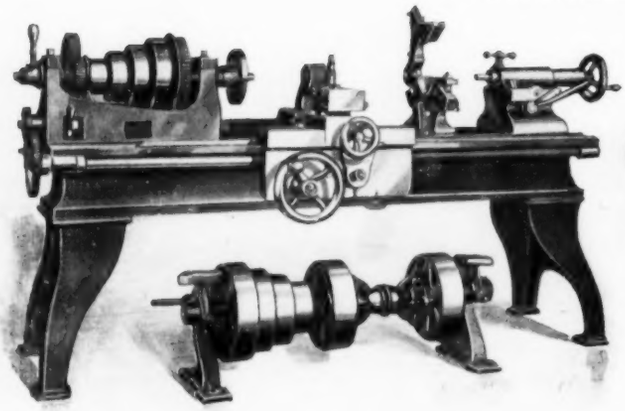


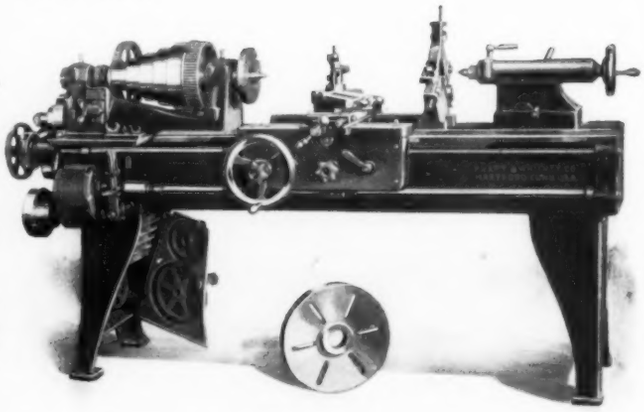
NEW HAVEN MANUFACTURING COMPANY.



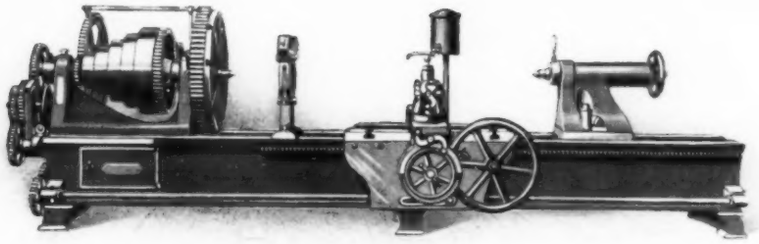


POND MACHINE TOOL COMPANY.





PRATT & WHITNEY COMPANY.



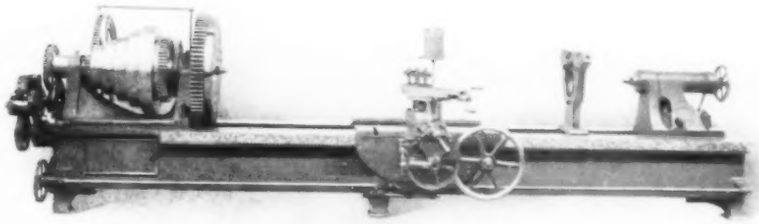
The elevating screw for each table, which was originally operated by a hand wheel at the lower end, is now actuated, through bevel gearing, by a horizontal shaft, the squared end of which is shown near the upper part of the table. The left-hand table of the later machine, it will be noticed, has three working surfaces. Each table, as now arranged, is adjusted horizontally by rack and pinion; and the saddle has in addition to power and hand feed along the bed a rapid hand movement by means of rack and pinion.

SHAPERS.

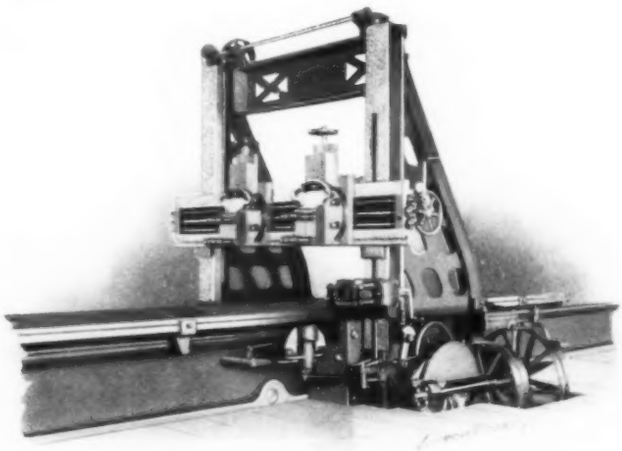
BEMENT, MILES & CO.

It has not proven practicable to get in all cases photographs of machines strictly comparable, and the older Bement, Miles & Co. shaper is 12 inches, while the later example is 26 inches. Yet the two are representative of shapers of their type as built in 1877 and at present.

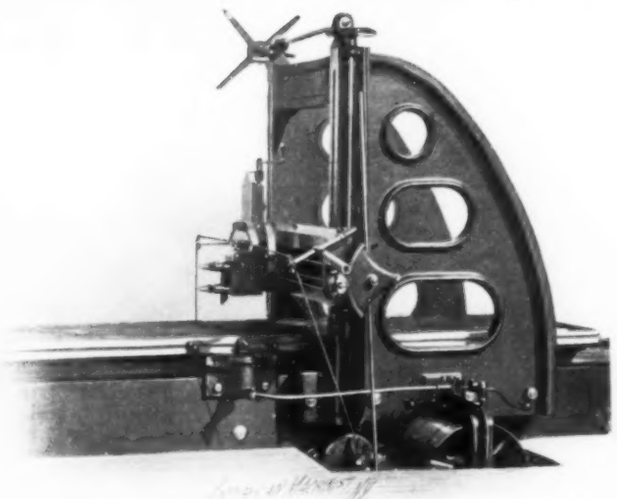
As would be expected, the machine of to-day is of somewhat heavier design; and the tables are better supported, the bed being of box form and resting directly on the floor instead of on legs, as formerly.

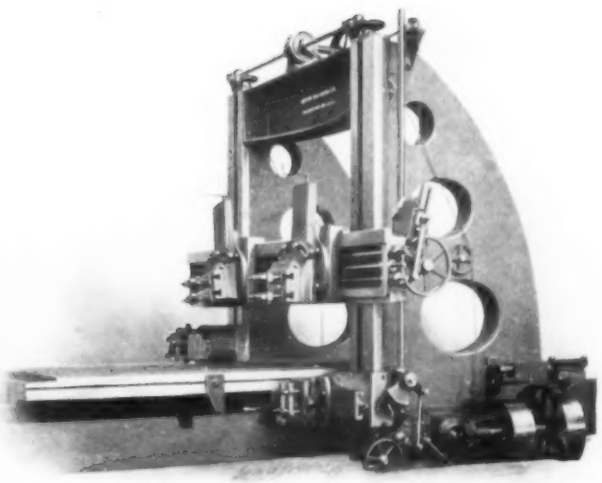


WILLIAM SELLERS & CO.



BEMENT, MILES & CO.

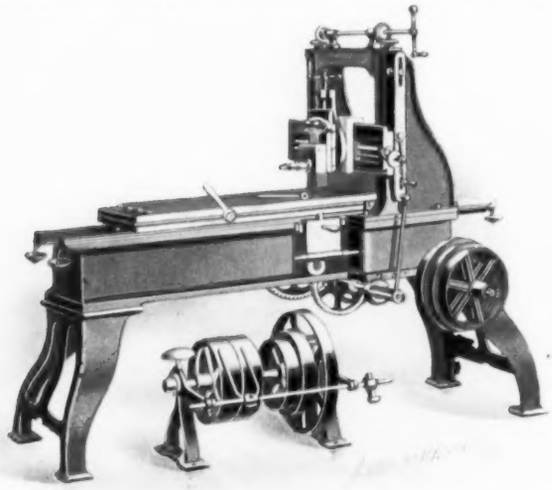


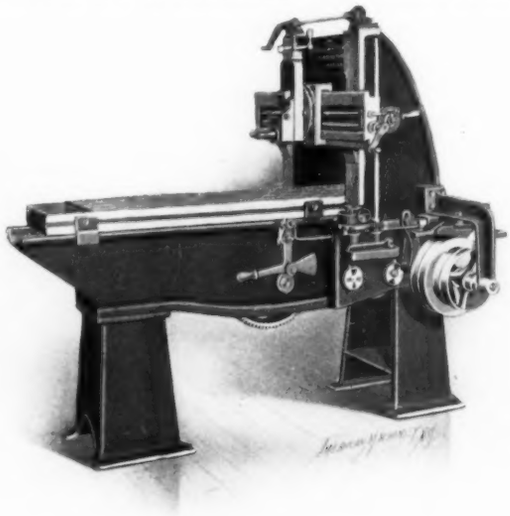


BETTS MACHINE COMPANY.

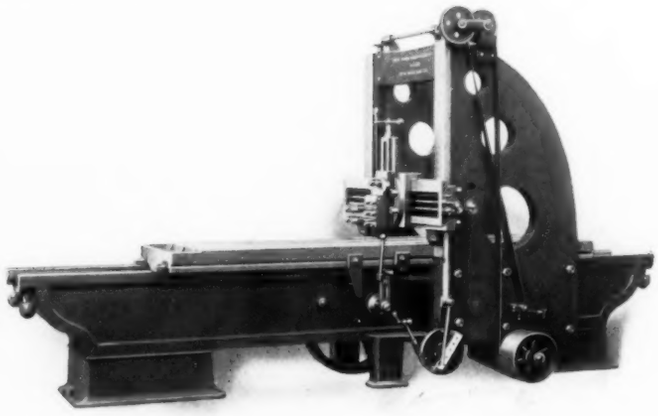
GOULD & EBERHARDT.

The photographs show clearly the difference between the shaper made by this company in 1877 and the one they now build. The new machine is much heavier, being made with a column instead of a built-up frame, and has a stiffer ram, a broader cross-rail, an extended base on which rests a support for the table, and a vise which has a graduated base and may be swiveled to any desired angle. The cross-feed and the stroke of the ram are more readily changed in the new machine; the ram has a greater range of speeds, and the speed may be instantly doubled or tripled by moving a lever shown at the rear of the column. The four-step driving cone is carried on a sleeve bolted to the column and thus the driving shaft, which passes through this sleeve, is relieved from all strain due to belt pull. The cross-feed connecting rod is provided with a friction socket which allows the rod to automatically adjust itself for any position of the table.

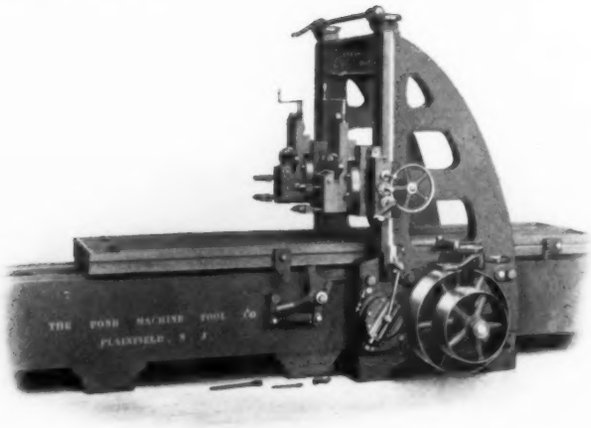




HENDEY MACHINE COMPANY.



NEW HAVEN MANUFACTURING COMPANY.



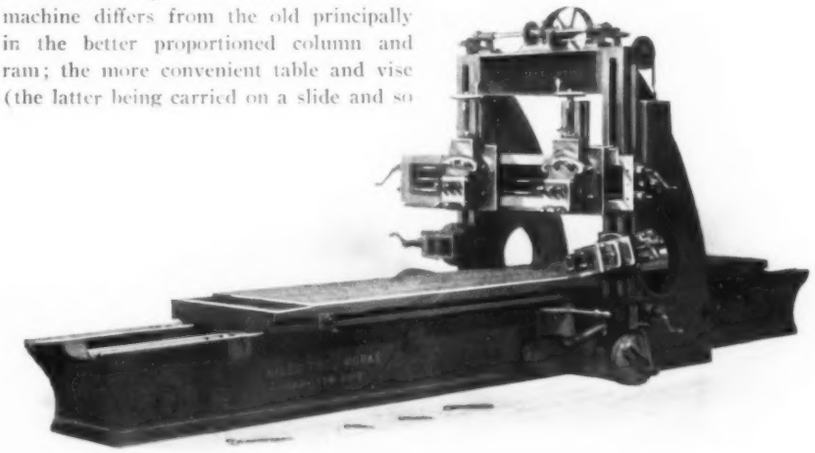
POND MACHINE TOOL COMPANY.

HENDEY MACHINE COMPANY.

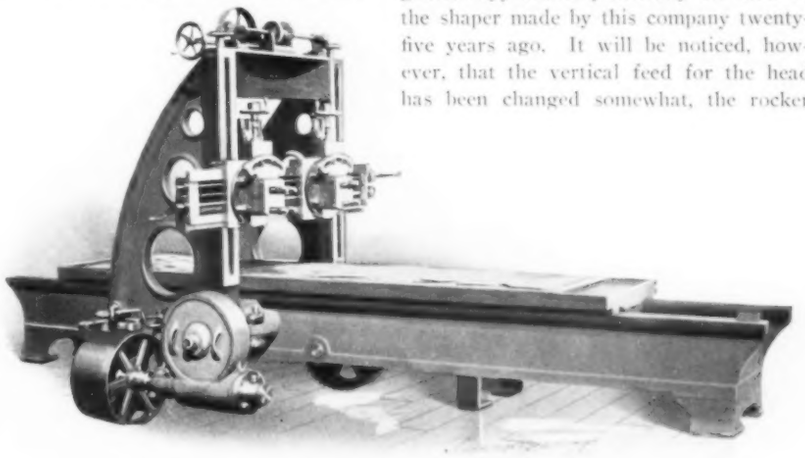
As the cuts show pretty clearly the changes made in the past twenty-five years, little explanation is necessary. The column, table and ram of the new machine are stiffer than in the older design; a more powerful drive is provided; the table, which is box shape, is so arranged that it may be tilted and work planed to any desired taper; the stroke of the ram is more conveniently changed, and, by means of a device on the reversing lever, may be very accurately adjusted after the dogs are set. Both shapers have 15 inches stroke and 15 inches cross-feed. The older machine planed work 8 inches high and weighed 850 pounds; the new shaper planes work 15 inches high and weighs 1,350 pounds.

PRATT & WHITNEY COMPANY.

The illustrations show a 10-inch shaper as made twenty-five years ago and their latest model 14-inch machine. The new machine differs from the old principally in the better proportioned column and ram; the more convenient table and vise (the latter being carried on a slide and so arranged that it can be moved to and from the column), and in the improved mechanism for changing the stroke of the ram, the stroke being changed now from the outside by turning a hexagon-head shaft passing through the disk shown in front of the driving cone, while in the old machine it was changed from the inside of the column. The weight of the new shaper with countershaft is 2,200 pounds, the older machine (10-inch) weighing 1,700 pounds.



NILES TOOL WORKS.

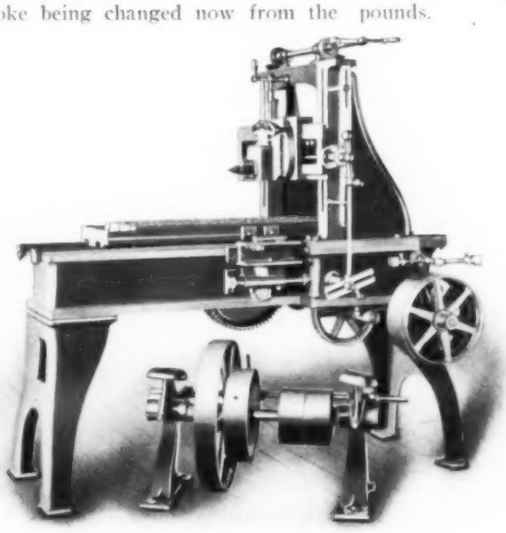


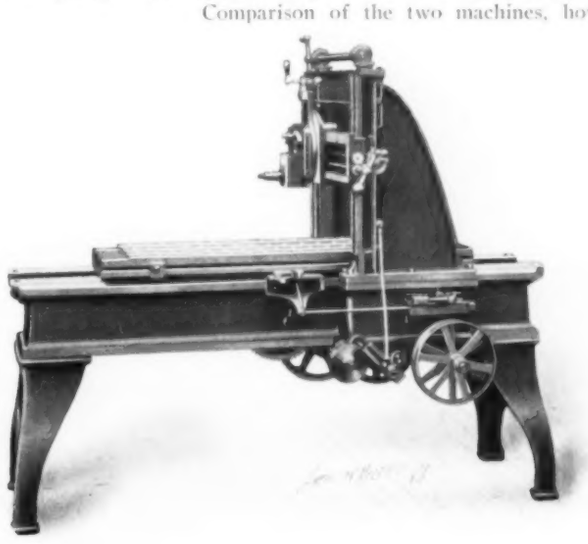
WILLIAM SELLERS & CO.

This tool as built to-day, while heavier and more powerful than formerly, is in general appearance practically the same as the shaper made by this company twenty-five years ago. It will be noticed, however, that the vertical feed for the head has been changed somewhat, the rocker arm for actuating this feed being originally carried on a vertical shaft at the back of the head, while now it is mounted on the horizontal shaft running through the top of the head, the gearing of course being rearranged accordingly.

MILLERS.

Milling machines are much more important factors in machine shop work to-day than they were twenty-five years ago, and work is now regularly done upon them of a character and at a rate scarcely dreamed of in 1877, at which time there were very few builders of them compared with their number now, and those few built very few varieties and sizes of machines compared with what they now build. As will be seen by the photograph, Bement, Miles & Co. were building a miller twenty-five years ago that might be judged by present-day standards and considered a very good example of machine tool designing. Comparison of the two machines, how-

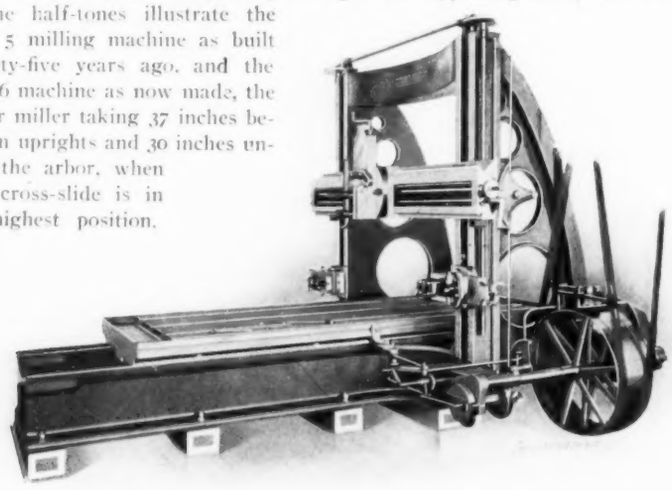




THE PRATT & WHITNEY COMPANY.

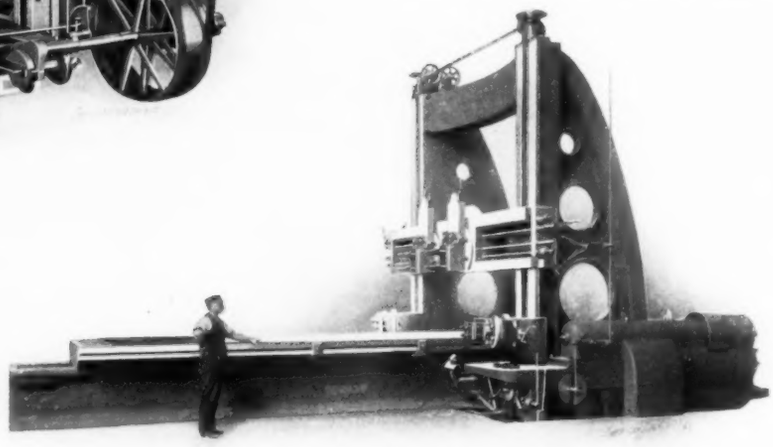
ever, shows the development of milling machines for machine shop use rather than the development of *a* milling machine, since the new one is distinctly of a different type and intended for a class of work not attempted twenty-five years ago.

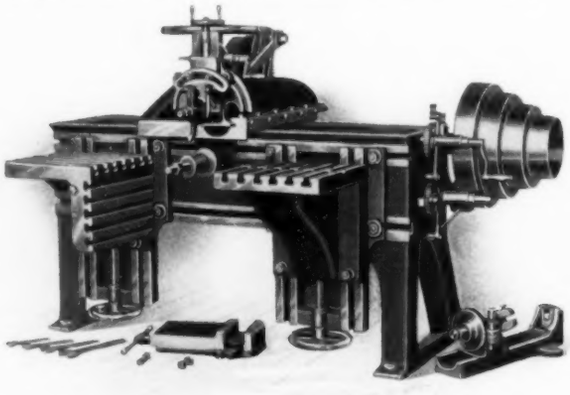
The half-tones illustrate the No. 5 milling machine as built twenty-five years ago, and the No. 6 machine as now made, the latter miller taking 37 inches between uprights and 30 inches under the arbor, when the cross-slide is in its highest position.

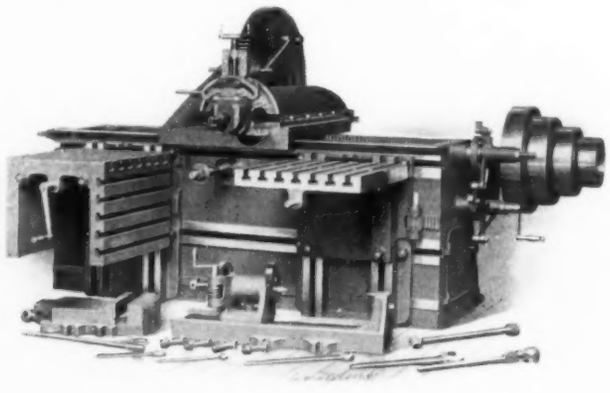


while the older machine shown measured 22 inches between uprights and 18 inches between table and arbor. The machines differ in nearly every particular. The changes made in the design of bed, housing, cross-slide and table; in the method of guiding the latter and gibbing it to the bed, and in the arrangement of the driving mechanism for the cutter arbor, are all clearly indicated in the illustrations. In the new machine the table is fed by helical pinion and rack movement. As the Sellers friction disks are employed, a great number of feeds can be obtained, the old machine having but five rates of feed. In addition to the feeds now obtained through the friction disks, the table has a rapid forward movement by power, and, by means of a clutch mechanism, has quick return movement at three different rates of speed. Automatic stops are provided for disengaging the feed at any desired point. The table has also a rapid and a fine adjustment by hand, the former by means of the large hand-wheel at the side of the machine, and the latter by means of the vertical shaft (arranged to be operated by a hand-crank) shown at the right of the hand-wheel. The method of supporting the spindle and cutter arbor is clearly shown. The cross-slide, which is so arranged that it may be elevated by power, is adjusted, to bring the cutter to the work, by means of the hand-wheel at the right. This cross-rail is arranged to receive, if desired, a vertical milling attachment adjustable to any position. In place of the drip cup, used on the older machine, the new miller is provided with an oil pump, and provision is made for taking care of the lubricant used in the cutters.

WILLIAM SELLERS & CO.







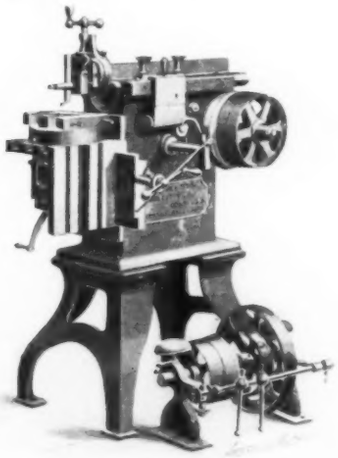
BEMENT, MILES & CO.

BECKER-BRAINARD COMPANY.

The original Brainard milling machine, as built twenty-five years ago, resembles the modern Becker-Brainard very little in appearance, and the operator handling them might have difficulty in persuading himself that the one was the progenitor of the other. The old machine had a superior feed belt arrangement—*i. e.*, a feed belt wider than common and running over a pulley the speed of which was considerably above that of the spindle, so that there was ample feed-belt capacity. No shaft with universal joints was used, but instead a shaft moving with the knee and by a suitable distance-piece keeping the feed driving cone always at the same distance from it, this distance being adjustable to take up slack in the belt.

A supplementary table with centers was provided, but spirals could not be cut with these, such work requiring the special spiral attachment shown at the right of the old machine on the floor. This could

be set upon the platen at the required angle and was at first fed by hand only, and later, means were provided for feeding it automatically. This was, so far as

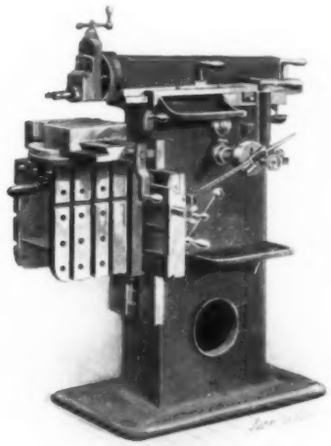


known, the first machine to use the overhanging arm and outer support for the spindle.

The new machine will be recognized as fully up to date. It has the straight, steel, removable arm, yoke attachment to the knee, an all-gear feed with levers for giving quickly any desired rate of feed, there being twenty changes for each spindle speed, with the rate of each indicated upon the gear casing. The old machine had an automatic feed for the platen only, and this could be reversed only by crossing the belt. The new machine has feeds for the knee and saddle in addition, and any feed is instantly reversible by shifting a small lever. There is a telescopic elevating screw, and the machine conforms in general appearance to the requirements of modern ideas in machine tool design. There is in this machine a clutch arrangement in the hubs of the hand-wheels, so that when the knee or the saddle has been set in a desired position, pressure upon a knob releases the hand-wheel, so that no accidental movement of the slide can take place. By the same arrangement the hand-wheels need not turn when the machine is feeding.

BROWN & SHARPE MANUFACTURING COMPANY.

Probably no other single machine has exerted so great an influence upon the character of machine-shop and toolroom work as has the universal milling machine, and if it were to be banished from our shops their efficiency would be very much



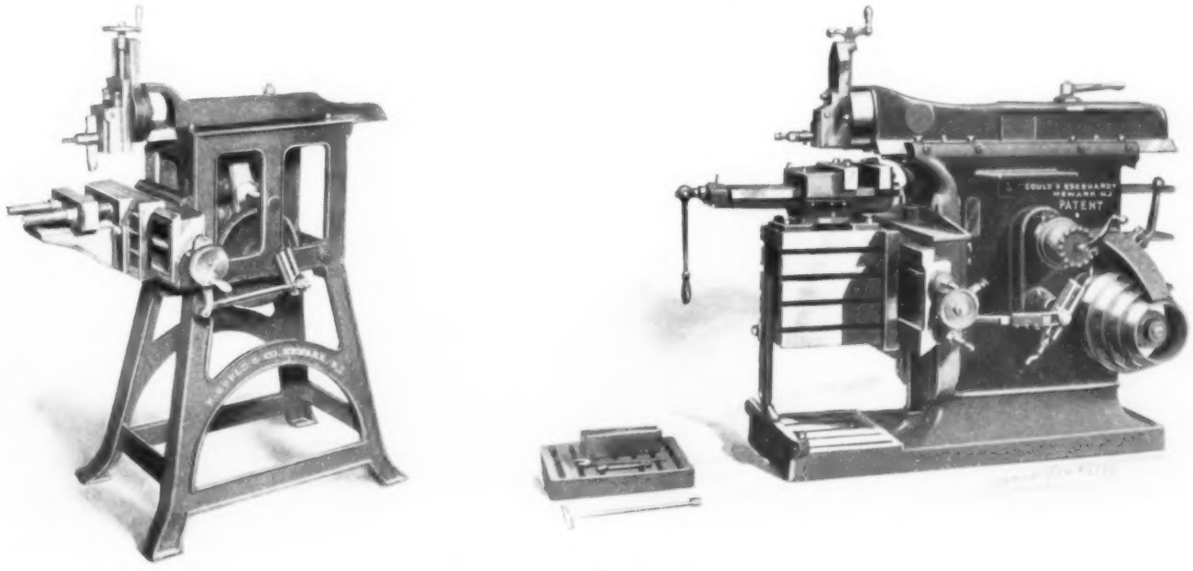
HENDEY MACHINE COMPANY.

reduced. It is the machine tool which, above all others, has intelligence and brains worked into it, and no other is capable of doing nearly so wide a variety of work. It will, within limits, do the work of the driller, planer and lathe, besides doing a wide variety of work peculiar to itself and which it is impracticable or impossible to do on any of the others named.

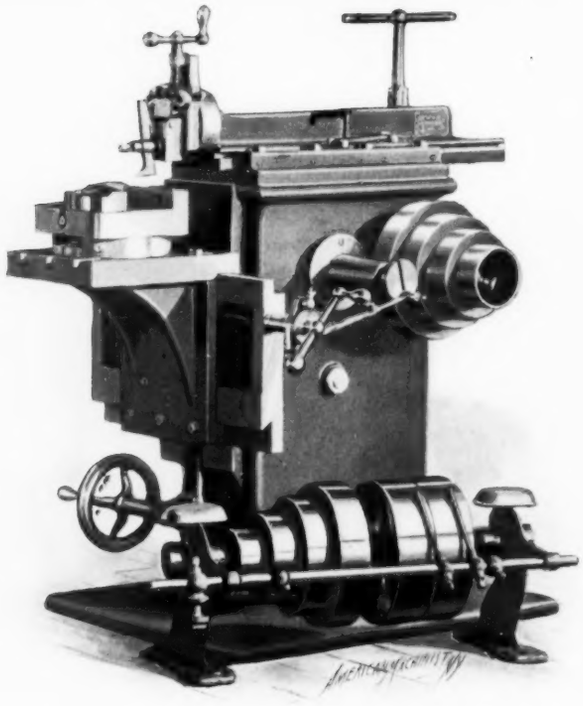
In the two engravings are shown the earlier and the latest form of the machine as built by the Brown & Sharpe Manufacturing Company, who first introduced it about 1865. The machine shown is, in point of fact, the first machine (No. 1), but it represents the machine substantially as built twenty-five years ago. The new machine, while it retains all the essential features, has in addition an overhanging arm, an improved design of spiral head, a geared feed driven from the spindle by a Renold chain, and an elevating shaft placed at an angle, so that hand-wheels may be attached to and remain upon both the saddle feed screw and the shaft referred to without interference. The main features of the improved spiral head are that, when elevated, the hight of the work above the platen is not nearly so much increased, and there is a plate on the spindle by which the more common divisions may be made in indexing without the tedious process of turning the regular index pin. The feed shaft is attached to the gearing at the side of the knee instead of at the end of the platen, and the feed motion goes upward through the center of the graduated swivel plate, thus making a feed which operates equally well at all angles of the platen and in either direction, with automatic stop. The spindle is hollow, and the facilities are provided for indexing *all* numbers up to 300 by the method which has been recently discussed and fully described in our columns and which is the latest development in milling machines.

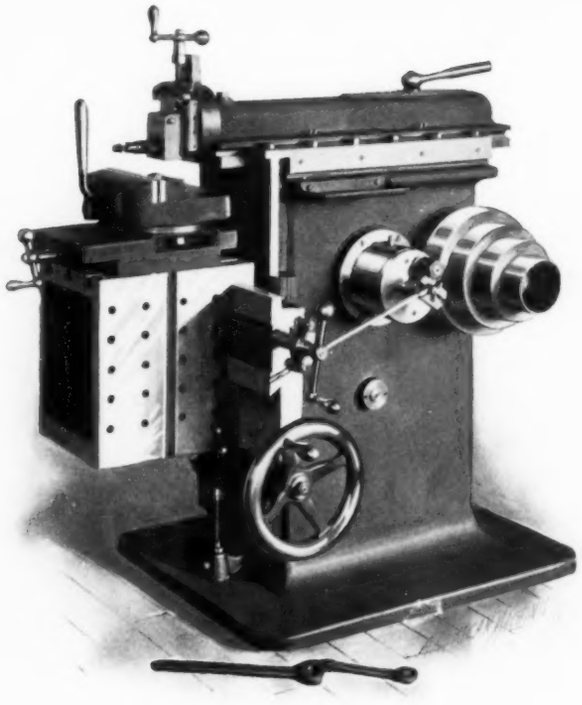
Twenty-five years ago the Brown & Sharpe Company made only two styles and sizes of universal millers, and only four different millers of all kinds altogether were cataloged; they now make five sizes of universals and sixteen different machines altogether.

We show also the heavier back-geared machine as built in 1877 and the corres-

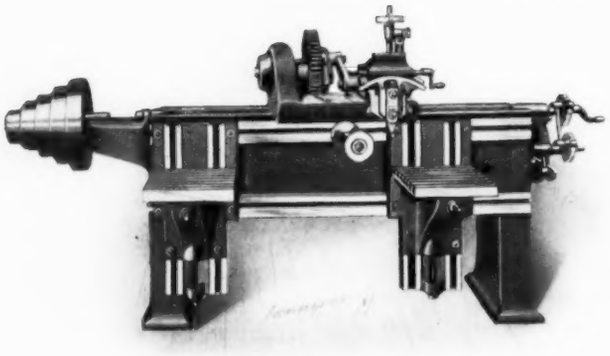


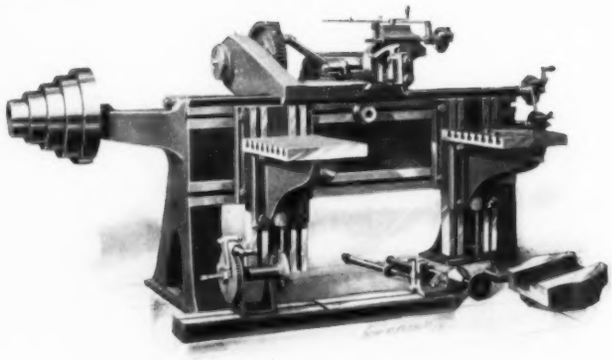
GOULD & EBERHARDT.



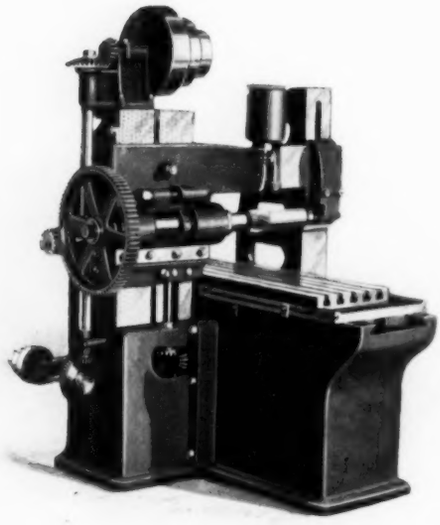


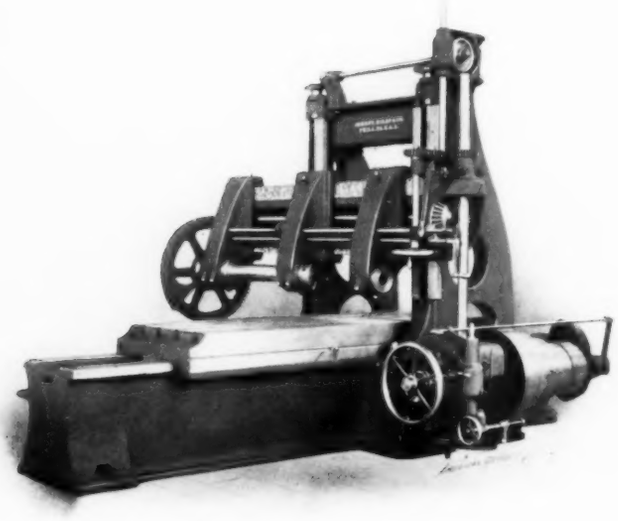
THE PRATT & WHITNEY COMPANY.





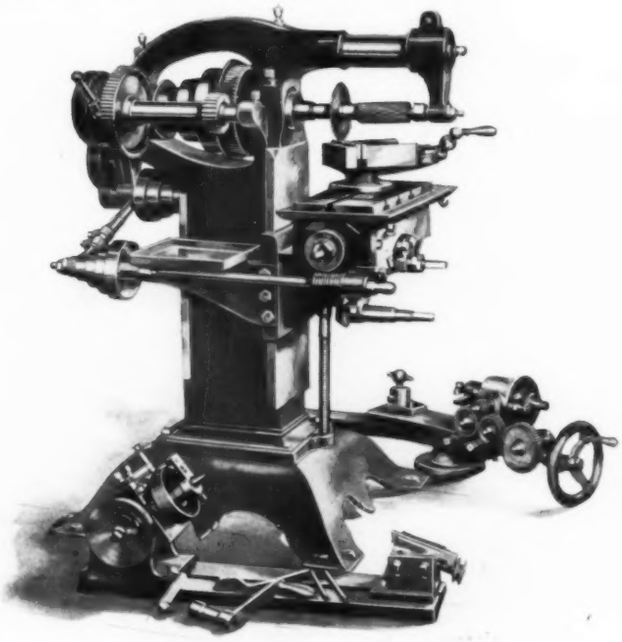
WILLIAM SELLERS & CO.

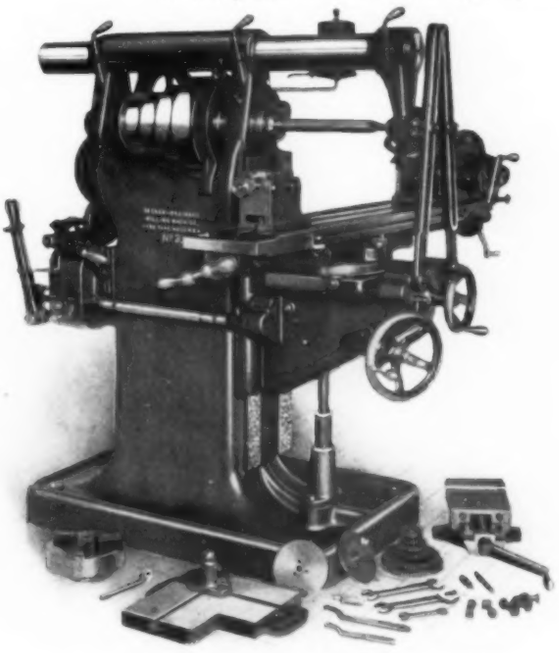




BEMENT, MILES & CO.

ponding machine as built now. The feed arrangement here is entirely different, being derived from belt pulleys at the rear of the machine, which drive the vertical shaft seen behind the elevating screw; motion for all the feeds being taken from this. It has a feed ranging from 0.004 to 0.21 inch per turn of spindle, and there is a quick return for the table by hand. Arm braces tie the outboard arbor support and the knee together when desired, adding very much to the rigidity of the machine and the amount of cut that can be taken with it.

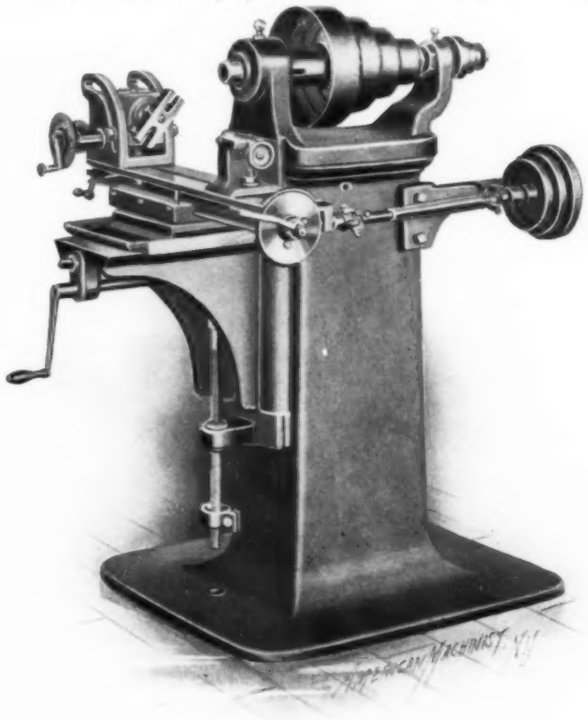


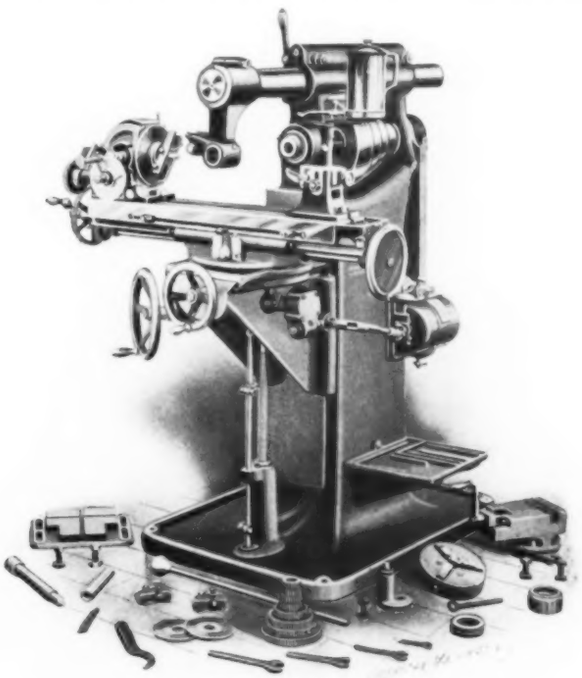


BECKER-BRAINERD MILLING MACHINE COMPANY.

CINCINNATI MILLING MACHINE COMPANY.

Twenty-five years ago Frederick Holz was superintendent of a screw and tap factory in Cincinnati. They wanted a miller for grooving taps, and Mr. Holz designed and built for that purpose the machine shown. He began with the idea that the spindle should turn in the same direction as a lathe spindle, and so placed the dividing head at the right-hand end of the platen instead of the left, as had been the universal and still is the general practice. The machine answered its purpose so well that a number of others were built, and later some of them were built for others. Finally, in 1889, the company sold out its screw and tap business, changed its name to the Cincinnati Milling Machine Company, and has been ever



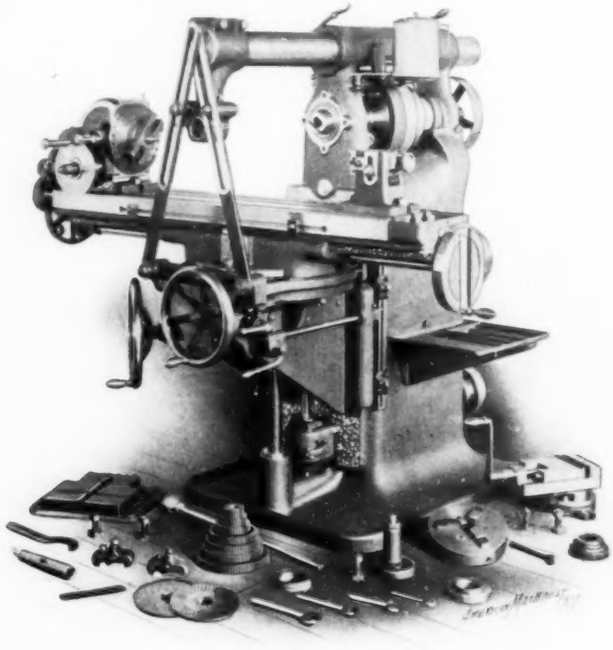


BROWN & SHARPE MANUFACTURING COMPANY.

since a very important factor in the milling machine business. They still adhere to the practice of placing the dividing head at the right, and they introduced the

tive feed arrangement, doing away with the feed belt and providing a system of levers with indicators showing just what feed is being obtained. The machine at

as for the platen; each is controlled by a separate lever and all are reversible by a lever in front of the machine. Not the least interesting thing about the machine

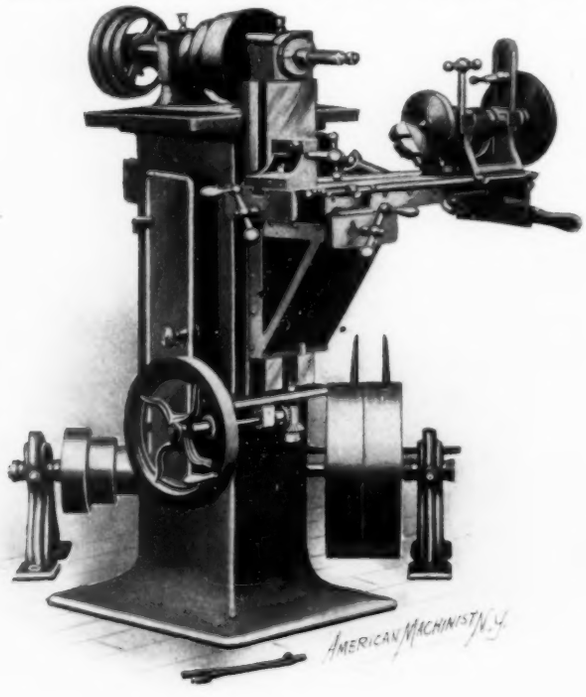


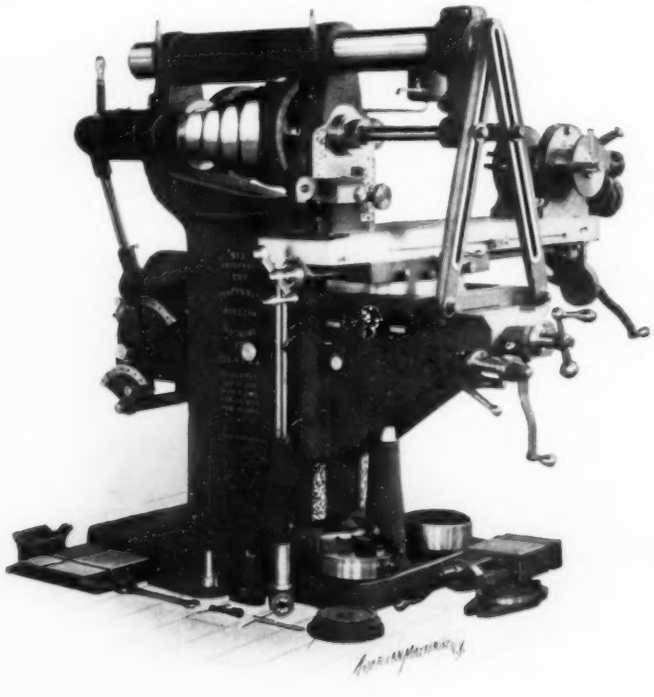
BROWN & SHARPE MANUFACTURING COMPANY.

practice of placing the shaft for the knee elevating crank at an angle, so that elevating and saddle movement cranks or wheels

the right is an example of the latest construction, in which the feeds range from 0.006 to 0.3 inch per turn of spindle, with

is the shop in which it is built, which is extremely interesting in many ways, and, thanks to the liberality of its proprietors,





CINCINNATI MILLING MACHINE COMPANY.

are always in place and can be moved simultaneously if desired. This has now become a regular feature of all modern machines. They also introduced the posi-

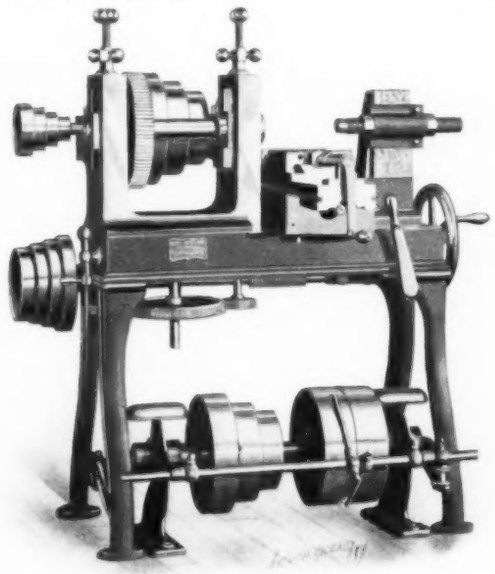
sixteen changes, and the spindle has also sixteen different rates of motion, ranging from 9 to 350 turns per minute. There are feeds for the knee and saddle as well

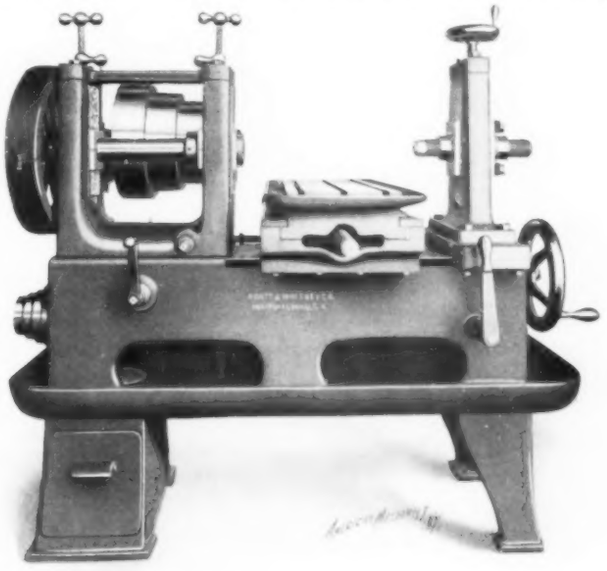
is very well known to readers of this journal.

PRATT & WHITNEY COMPANY.

This has long been one of the most

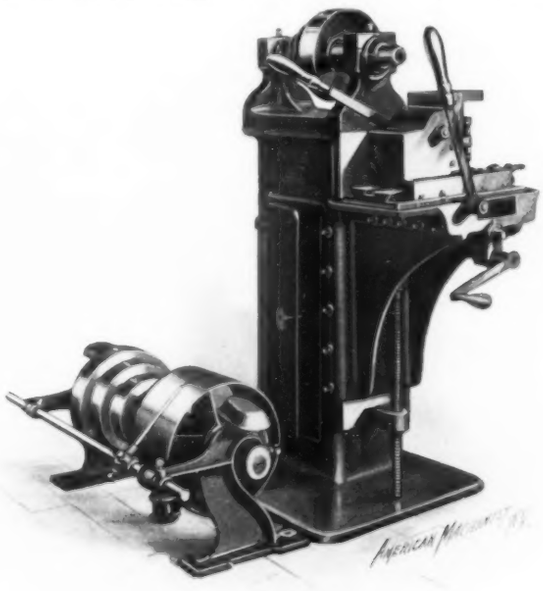
familiar machines in manufacturing establishments where small arms and similar articles are manufactured. The Pratt & Whitney Company has been the principal builder of such machines from the start, and the photographs give a good illustration of the tendencies of the past twenty-five years in machine-tool design. The new machine differs from the old principally in the increased depth of bed, the increased width of platen and saddle; in provision for catching and controlling the flow of lubricant used on the cutters; in much greater driving power, and in covered and protected gearing. In the new machine the spindle is adjusted vertically by means of the crank at the left instead of by the manipulation of a combined gear wheel and hand wheel below, as in the older machine. The outboard support for the cutter arbor is entirely different, being obviously much better supported, and provided with a screw for vertical adjustment. No finished surfaces are provided except where necessary for the working of the machine, but neatness is secured rather by careful attention to design. This machine weighs with countershaft 1,500 pounds, the weight of the older machine with countershaft being 1,125 pounds.

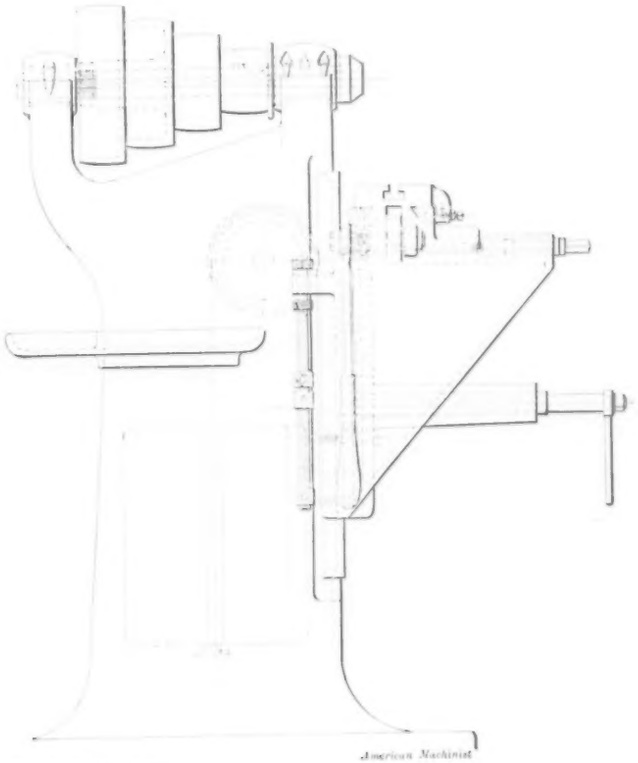




THE PRATT & WHITNEY COMPANY.

The line engraving gives a clear idea of the Pratt & Whitney 1902 model hand miller, and, after comparing the illustration with that showing the machine as built twenty-five years ago, a number of interesting differences will be noticed. The column and head of the miller, which were originally separate castings, are now in one; and the column is now provided with a pan or tray for holding wrenches, cutters and other tools. The cone pulley, it will be observed, is placed on the spindle with the small step next the front bearing, this arrangement being the reverse of the usual practice. The knee, which in the older model was elevated by a screw actuated by suitable gearing, is, in the new design, raised by means of rack and pinion, and counterbalanced by a weight inside the column. The table and saddle are entirely different in design from those



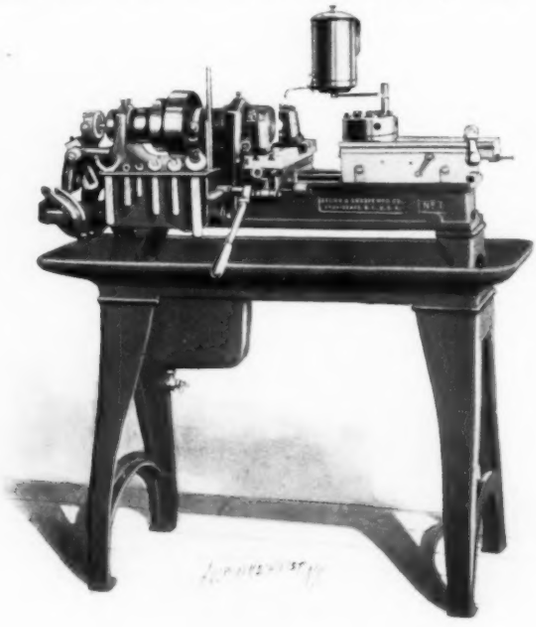


THE PRATT & WHITNEY COMPANY.

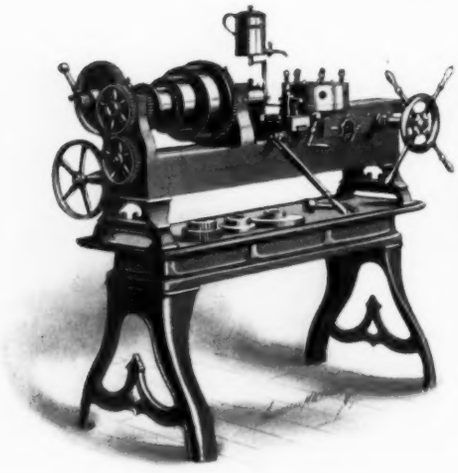
with which the earlier miller was provided; and the levers for operating the table, and the screws and check-nuts which serve as stops for table and knee, are now more conveniently arranged.

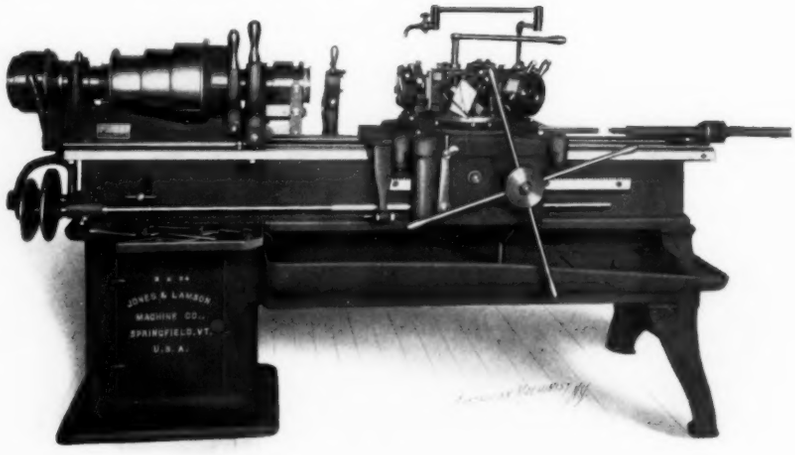
SCREW MACHINES—TURRET MACHINES.

Twenty-five years ago most all machines that used the turret for holding tools were called screw machines, and were used principally in making small screws and similar articles. Since that time, however, the scope of the machine has been very much extended, and the larger machines are now generally called turret

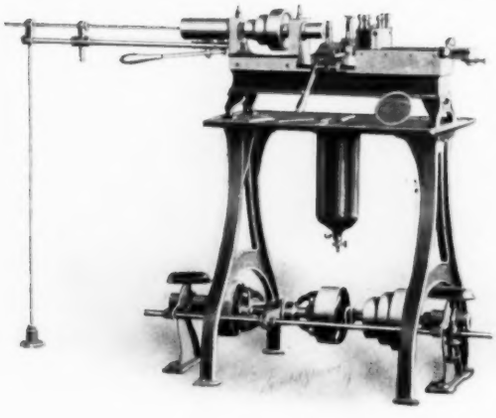


BROWN & SHARPE MANUFACTURING COMPANY.

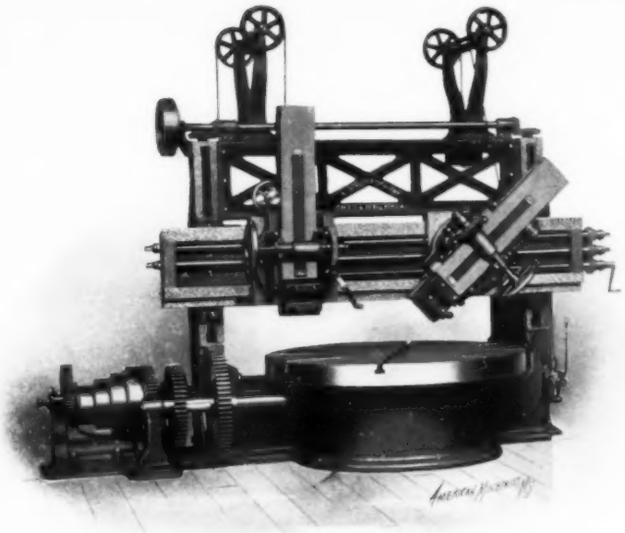


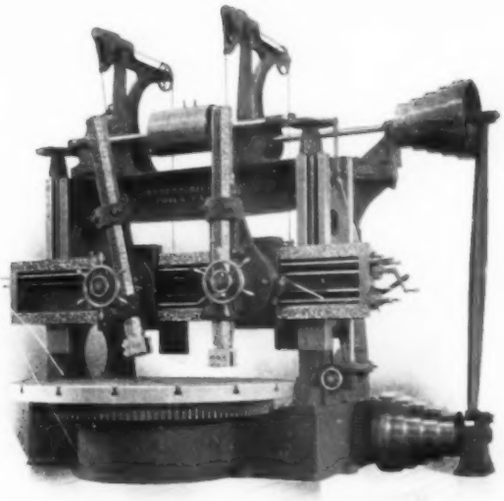


JONES & LAMSON MACHINE COMPANY.

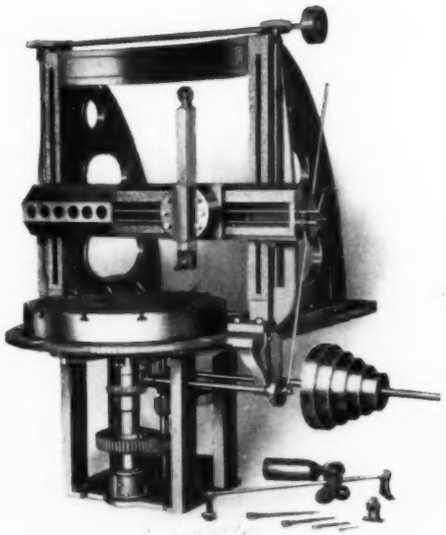


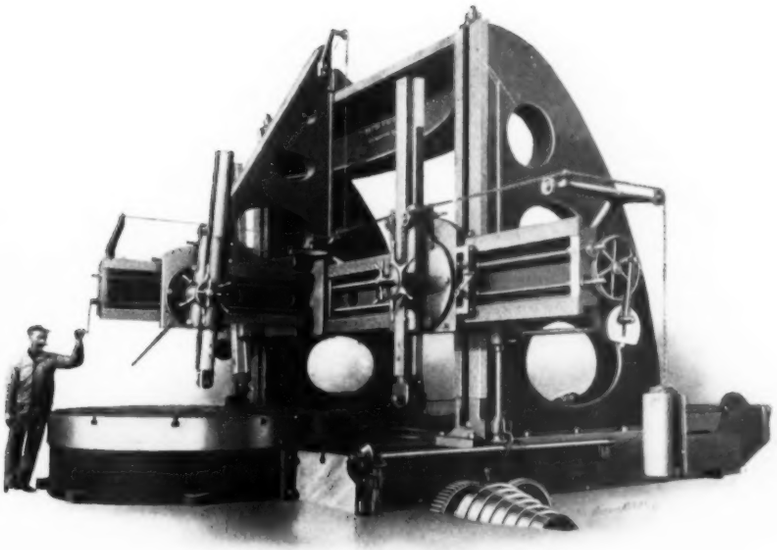
THE PRATT & WHITNEY COMPANY.



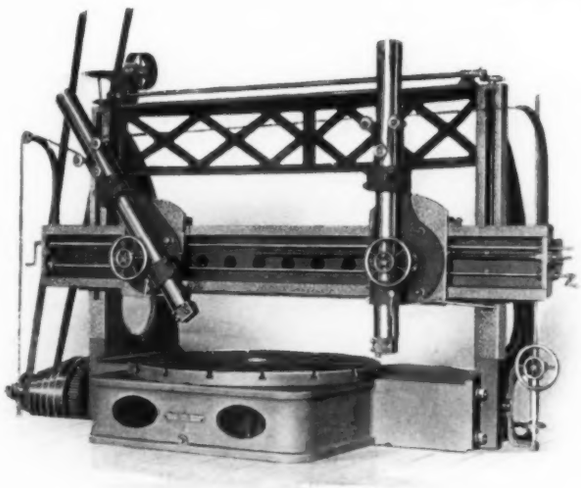


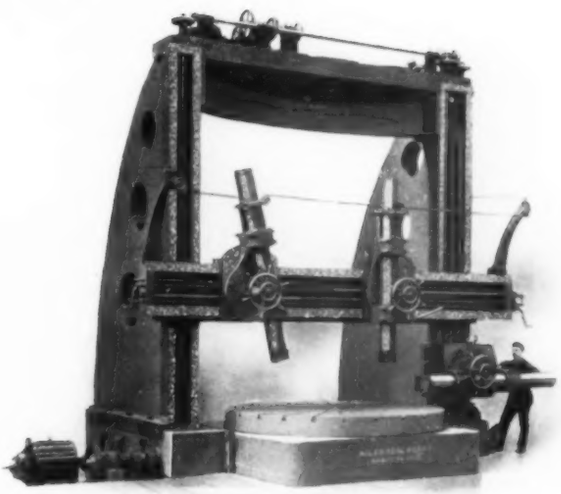
BEMENT, MILES & CO.





BETTS MACHINE COMPANY.



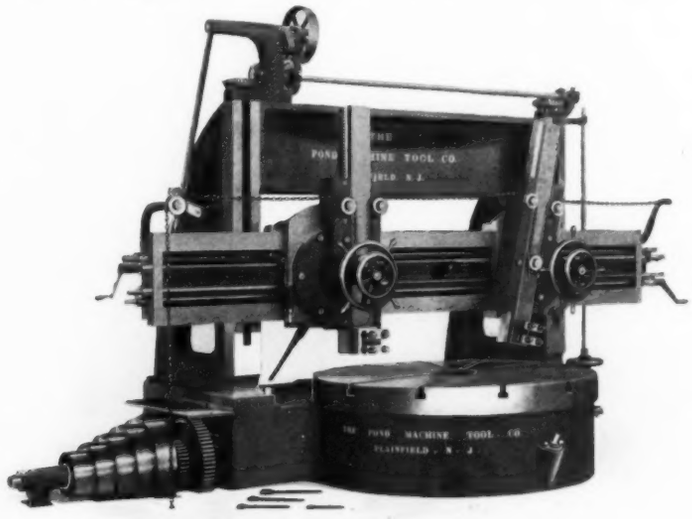


NILES TOOL WORKS.

machines or turret lathes. It is difficult, if not impossible, to draw a sharp line of demarkation between them, because they overlap each other's field somewhat, and they are here treated together. One of the most astonishing features of the case is the increased number of builders now as compared with 1877. The numerous automatic machines now built are also remarkable, such machines being practically unknown in machine shops twenty-five years ago.

BROWN & SHARPE MANUFACTURING COMPANY.

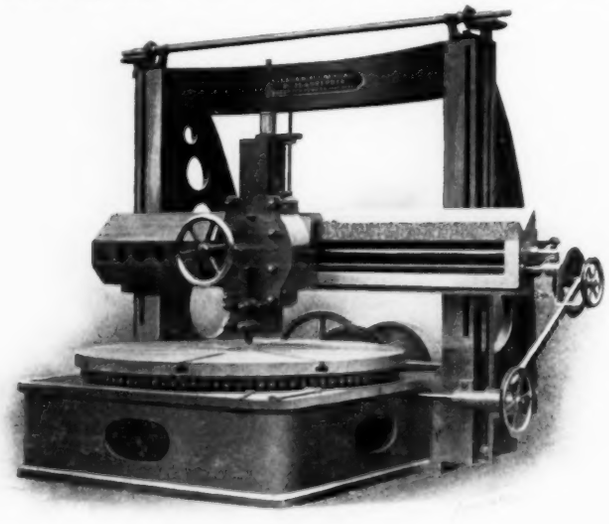
The development of one of these screw machines is represented by the engravings of the older and the newer Brown & Sharpe machine. In the older machine a hand-wheel at the back end of the spindle opened or closed the chuck, and when opened the weight seen suspended from a chain fed the rod forward to a stop in the turret. The chuck was then closed by another motion of the hand-wheel. With the new machine, when the operator has finished a piece, he moves the small lever seen projecting from the bed below the main spindle, and when this is done a shaft below the spindle is engaged, makes one turn and, by means of suitable cams upon the chuck, feeds the stock forward and closes the chuck again; all this being done with exceeding quickness, with almost no effort on the part of the workman, and so accurately that no stop is required in the turret to gage the length. The turret and cross-slide are operated in the same manner as in the older machine, but in the greater smoothness and symmetry of design, in the improved appliances for using and taking care of lubricant and in the provision made for keeping at hand all wrenches necessary to use in "setting up" or adjusting the machine, is shown the influence and the embodiment of modern ideas of machine tool design.

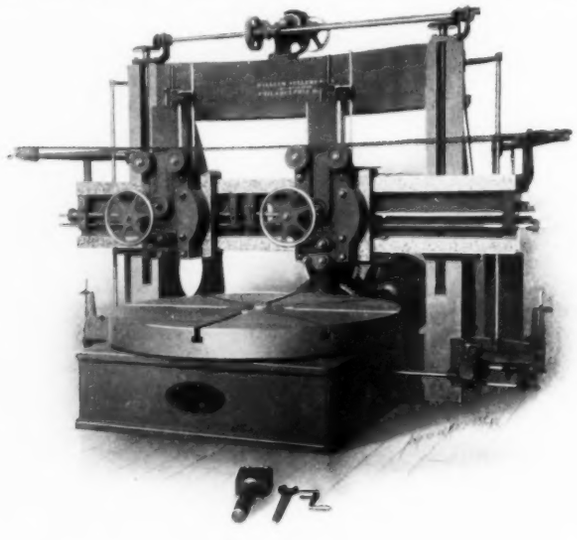


POND MACHINE TOOL COMPANY.

JONES & LAMSON MACHINE CO.

The Jones & Lamson Company, as probably most of our readers know, is one of the oldest machine-tool concerns in this country. For a long time it was among the leaders in the construction of a variety of machine tools, particularly for small arms manufacturing. These included turret screw machines, lathes, milling machines, profilers, trip-hammers, multiple spindle drillers and many other machines, all of which have been replaced by one machine, of which they build only one size. This firm claims to have originated the turret screw machine—a claim which, so far as we know, is not disputed. In 1855, or forty-seven years ago, they were building a screw machine embodying all of the essential features of the han!





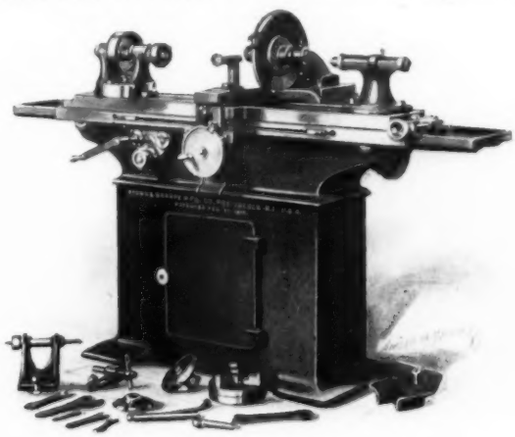
WILLIAM SELLERS & CO.

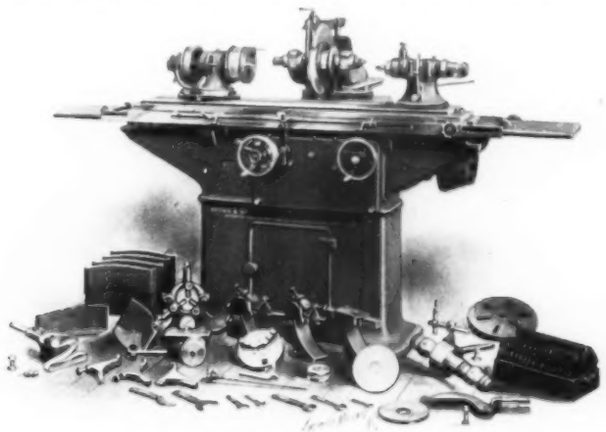
screw machine as made to-day, and at the time the AMERICAN MACHINIST was born they were making several styles and sizes of screw machines, including the one shown at the left, which is chosen from among their product of that day as being most fairly comparable with the machine they now build and which, though by an entirely different name, is yet within the same class and is intended for essentially the same work. Features of the old machine worthy of note are that the uprights composing the headstock are cast solid with the bed, and that there is a geared feed which, by worm gearing, moves the turret slide within a block that is movable upon the bed. The cross-slide is moved either by a screw or lever, and altogether the machine is quite modern in its features.

The machine at the right, however, which has taken the place, not only of the older machine shown, but of all others so far as the Jones & Lamson Company is concerned, was a distinct departure in turret lathe construction. Our readers are familiar with it, and with the fact that the low, flat turret permits tools to be bolted to its upper surface, which tools do not overhang at all and yet permit of turning work of any required length within the capacity of the machine. One of these tools does the cutting off so that a cross-slide for that purpose is not required; and the cutting tools, being readily adjustable for any size, make it available for advantageous use on work that comes in much smaller lots than would be within the range of economical handling by turret machines of the ordinary type. This machine was also the first, we believe, to be provided with an independent stop for each turret tool, each independently adjustable. This was made necessary by the fact that the old form of tool, adjustable to or from the center of the turret, was abandoned entirely, but it has proven a valuable feature for other machines as well. In the present machine the back gears are thrown in or out of action without stopping the machine; there is an automatic feed for the bar through the spindle. To this machine must be accorded the distinction, we think, of being among the few distinct entities in machine-tool construction that have been brought out during the period under review and that have exerted an important influence upon the cost of machine-shop work.

THE PRATT & WHITNEY COMPANY.

While the old machine shown is the No. 1 of 1878, the photograph represents fairly well the No. 2 of the same period. The latter machine had a chuck capacity of 11-16 inch, while the No. 3 handled stock up to 1 1-16 inches in diameter. This new machine, therefore, which takes stock up to 1 inch in diameter and turns a length of 10 inches, comes, as far as chuck capacity is concerned, between the old-style No. 2 and No. 3. The two machines illustrated differ in a great many particulars; the head, bed and pan of the new machine are all formed in one casting; the cone is placed on the spindle with the small step next the front bearing, and the turret, now hexagonal in form, instead of being carried on a slide moving in an adjustable block on the bed as in the older machine, is mounted on a carriage which travels directly on the bed. The ways, it will be noticed, are flat and beveled off on the outer edges. The new arrangement is much more rigid. A separate stop being provided for each tool, the tools can be more easily adjusted; and oil pump and piping being fitted to the machine, the tools are better lubricated than formerly. The old style No. 2 machine weighed 700 pounds; the new machine weighs 1,270 pounds.





BROWN & SHARPE MANUFACTURING COMPANY GRINDERS.

BORING AND TURNING MILLS.

Though it is probably true, as claimed, that the first boring and turning mill was built in England, the tool has since become distinctively American, is a regular feature of American machine shops, and has done much to reduce costs of doing certain classes of lathe work. For all work of considerable weight that is short relatively to its length and that must be chucked, it is demonstratedly far superior to the lathe. In England it is often called the vertical lathe.

BEMENT, MILES & CO.

The present boring and turning mill, which, as will be seen, is provided with motor drive, is much heavier than the one built in 1877; it has a more powerful driving gear and a greater number of speeds and feeds, the feed now being obtained by means of friction disks which admit of very fine adjustment. As the cone is placed at the right, from which side the feed for the tools, all movements of the heads and the raising and lowering of the cross-slide by power are controlled, the machine is more conveniently operated than formerly. The table has a large spindle provided with adjustable conical bushings fitted in the bed, and rests upon a broad annular bearing of large diameter. In place of the bevel gears, used in the earlier machine for driving the table, a spur gear drive is now employed. The change in the design of the cutter bars or tool slides is clearly shown, as is also the change in the shape of the heads, the latter being now offset so that the tool bars may be brought near together. It will be noticed that each head is provided with worm teeth and worm for swinging it to the desired angle. The gearing on the cross-slide is so arranged that, if desired, a fine feed can be taken with one head, in any direction, while the other head is carrying a coarse feed, either head being started, stopped or adjusted to feed in any direction independently of the other. Arranged thus the machine requires no overhead works and can be placed under a traveling crane.

WILLIAM SELLERS & CO.

The Sellers boring and turning mill as built in 1877 and one of the new mills made by the same company are clearly shown in the half-tones. The new machine differs from the old chiefly in the increased rigidity of bed, uprights, etc.; in greater driving power; in having two heads on the cross-rail and a counterbalance for each head; in the improved

friction disk feed for the tools, and in provision for elevating the cross-rail by power. The table, which in the earlier design rested in a V-shaped bearing, now has a flat bearing. The upper and lower edges of the rail, over which the saddles fit, are made square with the face, instead of being at an angle, as in the older mill; and both elevating screws are now right-hand, where formerly one screw was right- and one left-hand.

NILES TOOL WORKS.

The 12-foot machine of the later 70's and the present one are shown, and a glance at the photographs shows very clearly the advance that has been made within that period. At the time the earlier machine was made the Niles Works made a specialty of their boring and turning mills. The table was at that date supported for heavy work upon an annular bearing very near the periphery, and from this bearing it could be raised slightly by turning the square-headed screw seen in front near the floor, so that it then bore only upon the thrust bearing of the spindle and could be run rapidly for small boring or for other purposes. This feature is still retained, as is also the method of counterbalancing the tool bars, which in the time of the older machine was a new feature. The later machine is manifestly much heavier than the older, is motor driven and has a saddle with extra tool-bar fitted to the right-hand upright.

POND MACHINE TOOL COMPANY.

The illustrations show the Pond 8½-foot boring mill as made twenty-five years ago and the 8-foot machine built to-day. The new tool is of course much heavier and stronger than the older mill, and the various working parts are better supported. The table of the new mill runs on a bearing nearly as large as the table itself, it being formerly supported by its spindle only. Two heads are now provided in place of the one originally used, and the tool-slides are operated by rack and gearing, instead of by screw and gears as in the old design. The driving cones, it will be noticed, are arranged differently on the two machines, and the saddles, tool-slides, tool-holders and feed gear, as now made, are entirely different in design from those on the older mill.

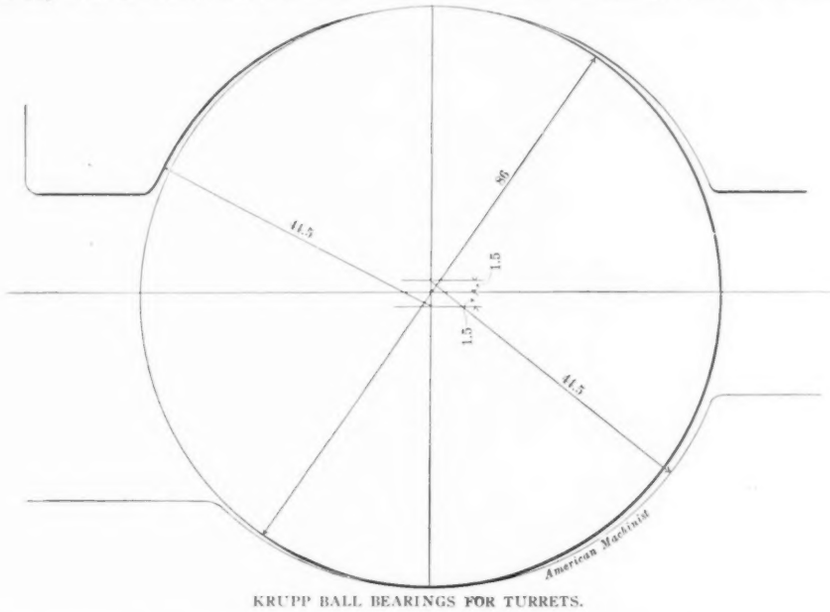
BETTS MACHINE COMPANY.

The older mill had but one tool-bar, which needed to go only half-way over the table, thus reducing the length of the finished portion of the cross-rail. The most striking difference perhaps between the old and the new design is in the depth of the bed, which, although it probably appeared all right to most designers of that time, is now seen to be a very weak feature of the machine; no amount of strength in the uprights being of any use, so long as they were connected to the table by such a bed. The new machine carries two, and sometimes three, cutting tools, and for the same capacity is fully 50 per cent. heavier. Instead of the ribbed patterns, the uprights, tables, beds, etc., are now made of the box form, so that the increase of weight does not fairly represent the increase in stiffness and strength. Where the shafts in the old machine ran in cast iron or babbitt bearings, they now run in bronze bushings, and steel is much more generally used for shafts, pinions, etc.

GRINDING MACHINES.

When the AMERICAN MACHINIST began, the universal grinder was a new and little-known feature of machine-shop equipment. It was being introduced, but was to be found in only a very few of the most advanced shops, was generally regarded as a machine by which very fine work could be done, and allowable only where one did not care much what work cost but only for its quality. Well-informed machinists do not regard it in that light now. The universal grinder of to-day will do better work than the one built twenty-five years ago, and it will do work of any required grade much cheaper—in fact, will finish work smooth and to size more cheaply than it can usually be done by any other method.

The machine shown as built in 1877 by the Brown & Sharpe Manufacturing Company is substantially as it is built to-day; but to go over the principal points in which it has been improved as a result of experience and of advance in the art of machine design, we mention some of the leading features possessed by the new machine which are not found on the old. In the first place, and by no means least important, is the matter of weight. Massiveness has been proven to be of special value in a grinder. In other words, weight for its own sake is desirable, after which considerations of the best distribution of metal come in. The 1877 grinder, including overhead works, weighed about 2,300 pounds; the modern one, which is practically of the same nominal capacity, weighs 3,500 pounds. The new machine is so arranged that the wheel spindle with its boxes comes out by simply loosening two screws; expansion of the work while in the machine is provided for by a spring which holds the tail center up to the work with a uniform pressure; it has an automatic cross-feed, by means of which work will be reduced to any predetermined diameter without further attention from the operator, and the internal mechanism is attached to the square plate seen in front of the machine which is dowelled and bolted in place, this conducing very much to economy of manufacturing and to convenience of access as well. Then the system of rests has been developed to a wonderful degree, so that a rough piece far too long and slender to support even its own weight without excessive flexure can be placed upon centers and rapidly and accurately ground without trouble. In the older machine provision was made for *dripping* water upon the wheel; in the new it is run on in a strong stream, as is in fact necessary when doing grinding at the rates which modern practice calls for.



KRUPP BALL BEARINGS FOR TURRETS.

"Notes on Naval Progress" contains the following:

"The use of ball bearings for turrets has been found by Krupp to give many advantages. For turrets weighing 200 tons, balls of 80 to 90 millimeters (3.15 to 3.4 inches) in diameter are used. For turrets weighing 300 tons the diameter is increased to 120 millimeters (4.72 inches). The weight carried by a ball of 80 to 90 millimeters is from 2,204 to 3,396 pounds, while that sustained by the 120-millimeter balls is 5,512 pounds. The ball track shown in section in the sketch is 15.74 feet in diameter and contains 152 balls of a diameter of 86 millimeters—3⅜ inches A guide rail is used to retain the balls in position."

THE AMERICAN TOOL BUSINESS IN GREAT BRITAIN.

By CHARLES CHURCHILL.

For somewhat more than the number of years that measure the existence of the AMERICAN MACHINIST I have been engaged in the business of introducing American tools to British workshops, and though at first I worked without it, this journal has been such a valuable assistance to the growth of the business here that I gladly embrace the opportunity of helping to celebrate its twenty-fifth anniversary. No one can tell, of course, precisely how much help it has been, because there is no way of ascertaining just what the business would have been without it; but that its influence has been a powerful one, and still increases, we have abundant evidence.

The advent of American tools and machinery into Great Britain began as a business about the year 1865. Previous to that date a few tools had been imported by engineers who had visited America, had there seen tools that were suitable for some special work and had purchased same for their individual needs, but no importer had brought the tools here for sale or had endeavored to introduce them as a commercial business.

The writer has been in England since 1862, having come here in charge of some special machinery for covering steel wire used in the manufacture of crinolines or hoop skirts, which were worn so generally by the ladies at that period. In that connection certain tools were required, and not finding them on this side of the ocean they had to be imported from the United States. The knowledge of such tools that the writer possessed led to the belief that a good market could be found here if they were introduced to the British engineers, and all of my time and efforts have since been devoted to that work.

The first tools thus introduced were American chucks made by the Cushman Chuck Company and E. Horton & Son Company. To these lines followed the Morse twist drills and, later on, the small tools of the Brown & Sharpe Manufacturing Company and other makers. The introduction of such tools did not meet with much favor generally. In many places they were looked upon as an attempt to introduce "American rubbish" and provoked the taunt that we were "bringing coals to Newcastle."

The period following the American Civil War, when there was much unkind feeling towards the States, was especially trying and made the task all the more difficult; consequently the business was at that time slow and almost discouraging, but persistent pushing and the fact that the goods were all that they were represented to be gradually overcame prejudice. The ten years first spent in that way showed sufficient advance to indicate the eventual success which is now familiar to all who are interested in tools. Having brought the small-tool business to a successful issue, we then began to introduce machine tools and to find a market for lathes, drills, planers, shapers, milling and grinding machines and other (special) machines. These tools met with a good deal of opposition from the workmen, who did not readily change from their old and fixed views of what a machine should be. The work of overcoming this opposition has not been light or easy, and in fact it is not yet entirely overcome, though there is so much less of it these days that by contrast, if not otherwise, our task seems easy. As we look back upon the work now we see that steady progress has been made; a curious feature of the growth of the business being that, if we disregard the "hump" in the curve of our progress, caused by the bicycle boom of 1896-7, the curve is generally regular and steadily upward.

One of the first plants of American machine tools placed here was for the Gatling Gun Company, whose works were started in Birmingham in the year 1889 under the management of an American, and this plant, when in successful operation, began to attract the attention of other works, and opened the way for other plants. Seeing is believing, and many doubters who could not be otherwise convinced that good tools could come from America, nor, in fact, from anywhere else except from British workshops, were compelled to believe the evidence of their own eyes.

The great bicycle-making boom gave a fresh impetus to the demand, and the introduction of automatic machines which were previously working in America attracted the attention of all the new works. Orders for all kinds of American machine tools flowed in freely, and their successful working indicated to engineers generally that tools which were so valuable in that line must be equally good for engineering work, and from that date the demand has steadily increased, so that to-day the output of the American shops is recognized as the up-to-date equipment, and though there are of course still some who stoutly assert what they seem to regard as the necessary superiority of British-built machinery, there are many who think differently, and, on the whole, American tools are fairly treated, most of the difficulties that now arise in connection with their use here springing from the fact that what is known as the "shop practice" of the two countries still differs considerably, so that for what at first may appear to be the same work the requirements may be entirely different.

The effect of the growth in popularity of the American tools is now seen in the fact that English toolmakers have been redesigning their own machines, and in many instances have adopted the American designs; in others, they have combined English and American designs, making, in their opinion, machines "more suitable for the English trade."

It is to-day very clear that the introduction of the American machines and tools is having a marked effect upon the trade here, and the next few years will, I believe, see great changes. For there is no doubt that a great awakening is taking place, and those who expect that the British manufacturer will stand still and let the world go by him will find out their mistake. The more or less complete reequipment of British workshops will take place, I believe, within the next few years; a significant fact being that to-day any new American tool, large or small, is looked upon with favor, both dealers and users are ready to examine and purchase on their merits, and generally entirely without prejudice.

When the writer began to introduce American tools there was not a place in Great Britain where they were on sale. To-day the small tools can be found in the shop of nearly every dealer in Great Britain, and they and the machine tools as well meet with universal favor among users.

With the increased use of American machinery here and the reflex influence such use has exerted, and still exerts, upon American design, it seems as though the shop practice of the two countries will eventually become more or less amalgamated, so to speak, and this will of course tend toward a constantly better understanding.

Having had the honor of being the first American to introduce these tools to the British market nearly forty years ago, I take special pleasure to-day in seeing the complete success of the venture and feel that this large and growing business in

tools and machinery is one of the ties that is uniting the two countries in a closer union of commercial and brotherly friendship.

The Machine Tool Progress of Cincinnati During the Past Twenty-Five Years.

No single fact in the progress of the manufacturing industries of the country during the period which is covered by the history of this paper is more striking than the growth of Cincinnati as a machine-tool building center. When this paper was established, in 1877, there were but three of what are now Cincinnati machine-tool building establishments in existence, while to-day that city builds far more machine tools than any other in the world.

Of the Cincinnati shops the oldest, by far, is that of John Steptoe & Co. This business was begun in 1845. At the time when we were born it was conducted under the firm name of Steptoe & McFarland. The business of the present Bickford Drill & Tool Company had been established by Henry Bickford, making what was then known as the Bickford drill. The firm of Holz & Mueller, the forerunner of the Cincinnati Milling Machine Company, was the only one of those now doing business which was then in existence. Their business was, however, the manufacture of taps and dies. Their first milling machine was made in 1878, but it was made for their own use, the manufacture of milling machines for the market not being taken up until about 1888.

This modest number of establishments showed no increase until 1880, when William Lodge, who had been previously engaged as a workman with Steptoe & McFarland, associated himself with William Barker and established the firm of Lodge, Barker & Co., which later became in succession Lodge, Davis & Co., the Lodge & Davis Machine Tool Company and the American Tool Works Company. Another descendant of Lodge, Barker & Co. is the firm of Wm. Barker & Co., which thus also dates from 1880.

The next year saw the beginning of the business of the present G. A. Gray Company, after which there is a gap until 1884, when the business of the Sebastian Lathe Company was started, and two years more saw but one more addition to the list—the present Oesterlein Machine Company, which was started in 1886 by Mr. Oesterlein, although the manufacture of the present line of product was not taken up until about ten years later.

The year 1886 may be said to close the ancient history period of the Cincinnati machine-tool industry, as, at this time, progress in establishing new firms became much more rapid, and the names of firms and corporations which are now household words among mechanics began to appear in rapid succession. The year 1887 saw the appearance of the R. K. LeBlond Machine Tool Company and the Fosdick Machine Tool Company, and in 1889 the Bradford Mill Company, now the Bradford Machine Tool Company, and Greaves & Klusman began the manufacture of machine tools. There is, however, another gap at this point—no new names appearing until 1892, which saw the beginnings of the Lodge & Shipley Machine Tool Company and the A. Streit Machine Company, as 1893 saw the beginning of the business of the W. E. Gang Company.

Between this year and the end of 1900, Smith & Mills, the Dreses Machine Tool Company, the Cincinnati Shaper Company, the Cincinnati Planer Company, the Cincinnati Machine Tool Company and the Belmer Machine Tool Company were organized, and 1901 with the present year has seen the organization of the Wais-King Tool Company, the Dietz Machine Tool Company, the Mueller Machine Tool Company, the Hisey-Wolf Machine Company and the Roach & Von Wyck Machine Tool Company.

CHARLES CHURCHILL.

The number of men employed and the amount of capital invested are not easy to arrive at. From the best figures we can obtain, we judge that there are not less than 3,500, and probably 4,000, men directly employed in the Cincinnati machine-tool shops. Very few of these shops have their own foundries and, of course, to obtain the total number of men who obtain employment through the industry as a whole, those employed in the foundries must be included.

Regarding the amount of capital invested, we may say that not long ago we made an extended investigation of this subject among machine shops, from which we are led to conclude that an investment of $1,000 per man employed is as accurate an average as can be established for machine shops doing work of moderate size. On this basis the capital invested in the Cincinnati machine-tool industry is between $3,500,000 and $4,000,000. Of course, in the matter of capital invested as well as in the number of men employed, the figures for the foundries should be included, but in this matter we have no data which can serve as even a rough guide. Of course, the amount invested in foundries per man is much less than in machine shops, but we think it entirely safe to estimate that the total amount of capital invested in this industry in Cincinnati is not less than $5,000,000.

From any and all points of view, the history of the Cincinnati machine-tool industry is one of the most creditable which our country can show. It has been practically created from almost nothing during the short period of fifteen years, and in its development two facts stand out with special prominence: It has been built up firstly by young men and secondly by mechanics. None of the Cincinnati shops was launched as a large enterprise. All have grown from small and modest beginnings and most of them were started by young mechnics with stout hearts, willing hands and level heads.

It is clear from a contemplation of the history of the development of the machine-tool industry of Cincianati that, however it may be in other lines of business, there has been a chance there in the machine-tool line for young men with push, energy and practical knowledge, but with limited capital; one of the greatest stimulating causes of this growth perhaps, if not the greatest, being the fact that the Lodge & Davis establishment for a long time pursued the policy of contracting certain portions of their product, sometimes helping the right kind of young men to secure an equipment for the shop work, and of course guaranteeing a steady sale. These contracts have in many instances resulted eventually in the branching out of independent concerns, not only in Cincinnati, but elsewhere as well, two of these being now located in Springfield, Ohio, and one in Milwaukee.

Nominations for Officers of the American Society of Mechanical Engineers.

The Nominating Committee of the American Society of Mechanical Engineers has completed its work, and the nominations are as follows:

For President—Wm. Sellers, Philadelphia.

For Treasurer—F. H. Stillman, New York city.

For Vice-Presidents—F. H. Daniels, Worcester; James Christie, Philadelphia; John R. Freeman, Providence.

For Managers—R. C. McKinney, New York city; S. S. Weber, Trenton; Newell Sanders, Chattanooga.

The present treasurer, who is the American correspondent of *The Engineer*, of London, and whose doings as such we have felt compelled to criticise, has for the first time in many years failed to receive the nomination for re-election.

A REVIEW OF PROGRESS IN MACHINE CONSTRUCTION.

By PROF. DR. REAULEAUX.

As one of the earliest subscribers to and regular readers of the AMERICAN MACHINIST, I would offer my sincere congratulations upon the anniversary it celebrates, and express the satisfaction which through so many years it has given me.

It seems worth while on such an occasion as the present to try to state which were the qualities of those treatises, descriptions, criticisms and letters brought forward weekly in the paper in a long series of years which have exerted the well-known attractive force upon their readers since the birthday of the paper. Passing the articles in review, one finds their dominion to be exceedingly wide and significant and at the same time always interesting, in at least several points when not throughout. It must be the system—the totality of the ideas represented in the articles—that captivates the reader. Because only an uninterrupted sequence of manner of observation and discrimination in the objects treated at just the right moment is able to exercise such an influence upon one's public, as we must perceive here.

One of the most interesting features of the AMERICAN MACHINIST directly connected with this endeavoring to be new every week is the historical character its volumes have assumed unobservedly. Indeed, the series of stout books requiring a good deal of space on the shelves of a private library teach history of machine construction for small tools as well as for gigantic machines. Looking, for instance, at the "chucks" of 1880 or so, you will find described and recommended strong, broad, somewhat clumsy but respectably constructed implements; then follow them volume by volume, and you will arrive, in the new century, at a nice, handy, much smaller, excellently manufactured lathe and drill-press appliance of undoubted mathematical precision, which is now indispensable through the shops and is on the market for a moderate price. Follow the lathe, to which it is applied, through the annual volumes, and you will see how the elder ones appeared in a kind of vacillating style; some improvements here and there, some in the forms of beds, some in the headstock, some in the prismatic guides, and then, with a bound, came the Norton-Hendey lathe with a handful of sudden improvements soon adopted by followers and improvers, quite like most new things.

Not so striking, but always of intrinsic value, are the improvements of the milling machine shown in its different styles, step by step, in the columns of the AMERICAN MACHINIST, and presenting high interest in their development of increasing delicacy and efficiency. The accompanying ma-

PROF. DR. FRANCIS REAULEAUX,
Kgl. Geheimrath.

chinery for transforming purposes, as boring, planing, grinding, riveting, forging, bending, rolling, etc., form a regular object of description and discussion.

The steam engine as a prime mover, how its constructive history runs in said columns. Horizontally stretched out on a heavy bed plate in the first annuals, uncovered, a remembrance of bygone years, and in the later volumes short, smooth in form, covered to avoid danger, excellently lubricated and excellently governed from the shaft instead of by belt contrivance, balanced against vibrations—approaching more and more the swiftness of Porter's brilliant engines. Further on the vertical engines of the Willans type with their piston-like valves and valve-like pistons of one-sided steam pressure (a revival of old and middle times), all parts concealed in a tent-like covering; but, not enough, history passes on: Laval's steam wheel and Parsons' steam turbine arrive on the scene, both opening a new perspective for stationary as well as for marine engines; that is what the volumes tell us without interruption.

Between all this special machinery is gliding, comparable to the helping inspiration of sensitive nerves, micrometric measuring, silently advancing and extending its dominion on both sides of the Atlantic, because it is daily more understood that interchangeability of pieces is the condition of their success. The AMERICAN MACHINIST has never left this truth out of view.

Great, or even enormous, changes have been brought about in the second half of the AMERICAN MACHINIST's five lustrums by the enlistment of the electric current as a carrier of power after having established itself in its great role of serving for lighting purposes. Recognized and praised as a power carrier as it is, the current does not so much enter into constructive details of transforming machines; its proper dominion of power, light and conveyor of messages is greater than nearly all others.

Another power carrier, provided with the quality of offering services to the machine shop, has shown itself in compressed air. The AMERICAN MACHINIST as a historian had told us in the first eighties how then traveling cranes were built and duly admired, provided with power by transmission rope, cotton or manilla; but later how compressed air superseded the rope. It is long ago that we began to apply compressed air in the railway brake mechanism, and then, as if it were a discovery, found out so great a number of applications that a big industry could successfully spring up for providing the machine builders, as regularly noticed by the AMERICAN MACHINIST, with these excellent tools. Each of them is a piston machine of the same fundamental principle as that of the once conquering hero, the steam engine. This machine of the eighteenth century has been in the last decades surrounded by such a number of competitors, not only the dynamos, but in enormous number by gas, oil, alcohol engines and other power producers, that even the AMERICAN MACHINIST finds it difficult to keep its readers fairly in possession of the statistics.

If we now examine the work of the AMERICAN MACHINIST as a whole, we dare

say that its literary contributions belong in the first rank of theory and application of transforming machinery and tools, to which it applies excellent descriptions and careful criticisms, whereas it treats prime movers and translocating machinery as mere companions of the transformers. The AMERICAN MACHINIST can, as we have seen—though unintentionally—serve as a reliable historical record for the technical scholar, and, in consequence of the regular and sharp observations it has made intentionally regarding the class of transforming machinery, it has also done excellent service to technological science, and Science will sooner or later express to it her thanks.

A Quarter of a Century of Machine Tool Development as Recorded in the Pages of the American Machinist.

We are telling in this issue what the AMERICAN MACHINIST has done in the full course of its existence in recording in detail, and as nearly coincident with the events as possible, the successive steps in the development of the tools of the machine shop and its allied industries. This is not meant to be done in any spirit of boasting, nor merely for the sake of showing how faithful and complete has been the work done. We simply take advantage of the anniversary occasion to give to the trade a view not often obtainable of the manner and scope of the world's progress in the working of metals. It has been the life business of the AMERICAN MACHINIST to tell constantly what has been doing in the trades with which it has been affiliated, and to show each successive improvement in tools and machines, especially those of the United States, as soon as it has been accessible for publication.

The following is a brief summary of the engines, motors, machine tools, power-driven machines of the shop of various kinds, etc., which up to October 1 of the present year have been actually described and in every case illustrated in our columns:

Steam engines, including pumping and hoisting engines	323
Gas, oil and other engines and motors	70
Steam and power pumps	115
Steam boilers	81
Lathes	274
Planers	109
Drills	374
Shapers, including slotters, etc.	96
Millers	202
Turret lathes and screw machines	119
Boring mills, vertical, horizontal, and in various combinations	156
Grinders	200
Gear cutters	59
Bolt cutters, nut tappers, facers, etc.	52
Pipe cutters, etc	32
Power presses	103
Punches, shears and tools for boiler, bridge and ship work	153
Miscellaneous machine tools	398
Foundry tools and appliances	70
Blacksmith tools and appliances	63
Wood-working machines	249
Various machines not included in above	199
Total	3,487

The cuts illustrating the machines here enumerated include, after all, only a small portion of the total number of cuts which have appeared in our columns since the beginning. Thus in the year 1901 the total number of separate cuts in our reading columns was 1,673, and of this number only about ten per cent. were of machines which would be included under any of the items of the above summary of complete tools that have been shown. Our illustrations have been largely devoted to small tools and appliances for shop use, to the numerous devices and operations described or discussed by our "practical men" correspondents, to the elucidation of mechanical principles, the details of constructions and contrivances for facilitating work and to various incidental matters of interest and profit.

As an illustration of the enlargement of the paper we may note that in 1886 the first complete year of the weekly edition, the total number of cuts was 655, or but a little over one-third that of the year last finished. This does not tell the whole story, as it will be found that our cuts now often include a number of separate figures, which the earlier ones rarely did.

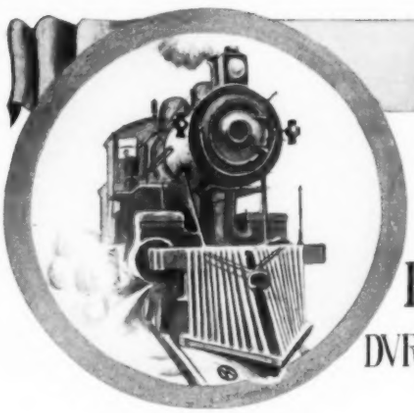
In the beginning of our course it would appear that the paper was almost more of a steam engine paper than a machine shop paper. Note the number of engines, steam pumps and steam boilers in our list; these mostly appeared in the earlier years and rarely grace our columns now. The narrowing of our field and still the constant growth in the amount of available matter pertaining to machine development indicate that our progress is constantly at an accelerated pace. Sometimes when we stop to think of the improvements that have been made in our brief span of time we are tempted to believe that the era is an exceptional one, that we have run away with ourselves and have overdone things, and that by and by there will be a reaction, but the record of the AMERICAN MACHINIST says that upon the whole the pace has been increasing and that the later the year the greater is the advance for the year, or at least, as indications of progress, the greater is the number of improved machines appearing.

It would seem that although improvements have been numerous and the total gain in facility enormous, no prominently great things have been done. No towering genius has been at work in our shops anywhere. Some few machines have been brought out that can be called new machines, and in each of these there has been the embodiment of a happy idea with much thinking over and selecting of details in the construction of the machine before it has been put forth; but the greater work, after all, has been upon the standard tools of the universal shop, the lathes, planers, drills, shapers, millers, boring mills and the other members of the family. The development of these as a whole has illustrated the operation of the law of evolution by successive departures from existing types and the continuous survival of the fittest as completely as ever Darwin found it in plant or animal life. Indeed, in the development of the machine tool the law would seem to have worked more uninterruptedly than in nature, for while there have been, as was said, few great leaps of progress, there have been also few serious startings in wrong directions and few "improved" machines have had to be abandoned as mistakes along the way.

The most prominent event affecting recent mechanical development has been of course the wonderful growth of electrical devices. This has had a double bearing on the trade. It has called for new methods and facilities for manufacture, so that the electrical machinist represents almost a new trade, and certainly an important and abiding branch of the trade, to endure as far as we can see in the future. And then the facile and adaptable electric motor has led to the redesigning and reconstructing of many tools to be more directly and conveniently driven by it.

The bicycle manufacture may have been only a spurt, but it was one which showed the modern machinist in a most favorable light. The rapid designing and building of special tools for this peculiar and novel line of manufacture was a marvel, and those tools, as successively shown in our columns in 1895 and 1896, constituted a wonderful group of highly ingenious yet practical and successful inventions. It is not yet time to speak of what the autocar and the automobile may demand of the machinist, but the recent past carries the full assurance that he will not be found wanting.

A secondary function of the technical journal which it has been the special mission of the AMERICAN MACHINIST to maintain is not so easily statable and certainly is not fully appreciated. Our work is by no means merely the continual showing of the novel and more advantageous devices, the making known of what has hitherto been unknown to any, but also the bringing to the knowledge of the many what may have been already well enough known to the few. It is as essential, if not more essential, to stimulate than to merely inform. The high ability of the few is a small matter compared with the productive efficiency of the many. By the promotion of the latter the greater world is the gainer. We work therefore not alone for the trade, but in the ultimate for all mankind, for all are the customers of the machinist.



GROWTH OF THE LOCOMOTIVE DURING THE PAST QUARTER-CENTURY

By O. H. REYNOLDS,
Of the American Locomotive Company.

In a consideration of the most distinctive features of locomotive design in the past twenty-five years, the increase of proportions of the old familiar types and the introduction of some ideas entirely new and strange in the proportions of boilers, and also the wheel arrangement, stand out prominently. At the beginning of that period the American type, or eight-wheel engine, was in general use for all classes of service, and engines known as moguls, ten-wheelers and consolidations, while at work at that time, were the exception, and were confined principally to mountain roads. The best and heaviest of the eight-wheel engines of that time had 18x24 cylinders, 62-inch wheels, and a total weight of 100,000 pounds. An average consolidation engine of the same period had 20x24-inch cylinders, 50-inch wheels, and total weight of 105,000 pounds. There was but a slight difference in the grate area and heating surface of these engines, and this fact explains why the eight-wheeler gave satisfactory results under all conditions of service. The question of heating surface was then beginning to receive some attention, as was also the correct ratio of adhesive weight to cylinder power, many of the older engines being notoriously deficient in this particular—that is, badly over-cylindered. This condition proved easy of adjustment, since the requirements of an increase in heating surface implied a larger boiler, and therefore more weight on drivers. The effects of this correction are seen in the later engines, which, having properly proportioned heating surfaces, have the weight to hold the rail against maximum traction force.

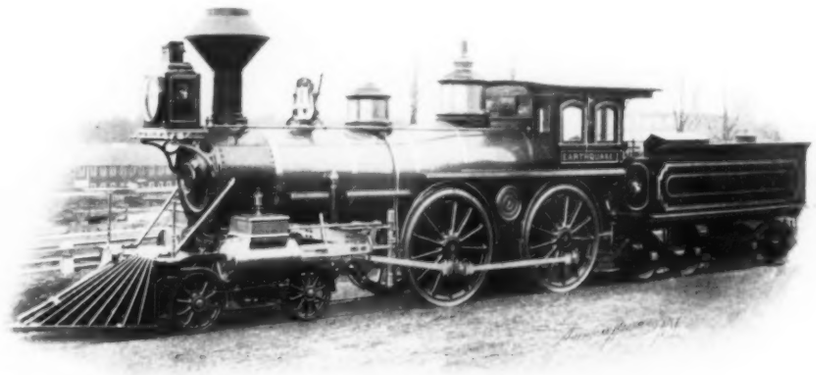


FIG. 1. 4-4-0 PASSENGER ENGINE OF 1877. MANCHESTER WORKS, NOW AMERICAN LOCOMOTIVE COMPANY.

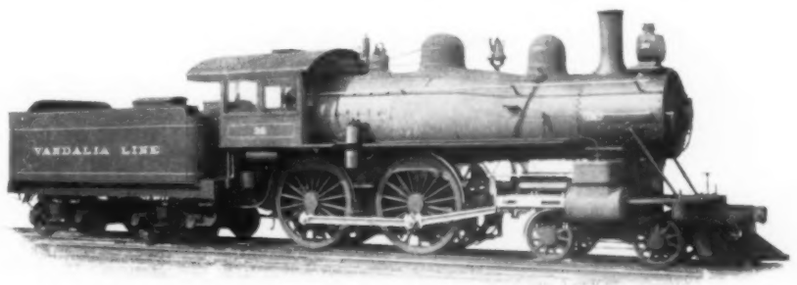


FIG. 2. 4-4-0 PASSENGER ENGINE. SCHENECTADY LOCOMOTIVE WORKS.

The slow processes by which these improvements were effected are shown when it is seen that it was not until about 1886, when the need of heavy power continuing to press itself on the management of progressive roads, that some consolidation engines, having 22x28-inch cylinders, 49-inch wheels and total weight of 150,000 pounds, were built. From that time on, the trend of locomotive building has been in the direction of heavier power. The compound locomotive made its appearance about 1890, and was for several years in the experimental stage, but has since been perfected, in the struggle to produce a horse-power on the least expenditure of fuel. Of this type of engine there are the two-cylinder or cross-compound, the tandem compound and the four-cylinder compound made in this country. There is no question as to the fuel economy effected by this type of machine.

Construction continued along the lines thus established until about 1900, when the demand for improvement in the single-expansion engine resulted in increased boiler-power, a boiler having a greater heating surface than any previously built. Large fireboxes had been found a necessity to burn anthracite coal successfully, but it remained for recent experimenters to demonstrate that there was economy in the large firebox for bituminous coal, and they are now used on the latest productions. As an indication of the improvement in this respect, it is now the practice to make the boiler practically as large as can be done within the limit of weight, and the result is about 100 per cent. increase of heating surface in new engines over the old for the same class of service. In order to obtain this increase of boiler-power, all parts below the boiler are made as light as possible consistent with strength to withstand the stresses they are to resist. Steel has therefore been called into use to replace parts formerly made of cast

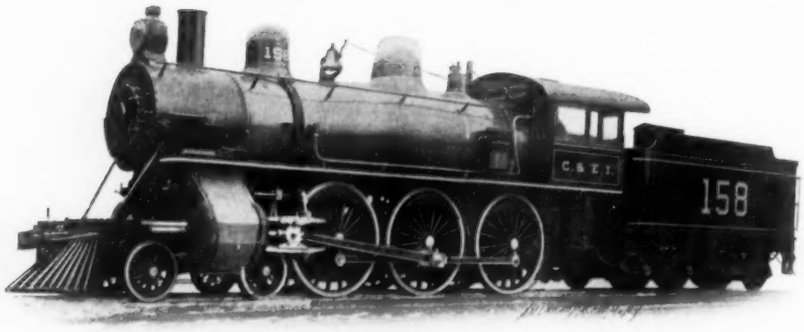


FIG. 3. 4-6-0 TWO-CYLINDER COMPOUND PASSENGER ENGINE. PITTSBURGH LOCOMOTIVE WORKS.

or wrought iron. Among these parts now largely constructed of cast steel are: Driving wheels, driving boxes, frames, footplates, furnace-bearers, rockers, guide-yokes, frame braces and equalizers. This practice makes a saving of several thousand pounds, which is advantageously used in the larger boiler.

The full significance of this increase in size of boilers will be grasped by a reference to the engravings of three boilers which represent, first, a crown-bar boiler of 1876 for a 17x24 eight-wheeler, in which the heating surface of firebox is

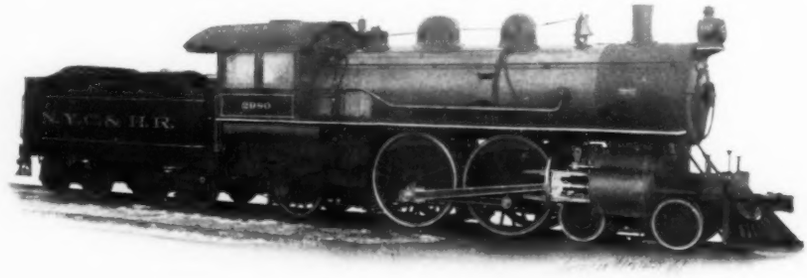


FIG. 4. 4-4-2 PASSENGER ENGINE. SCHENECTADY LOCOMOTIVE WORKS.

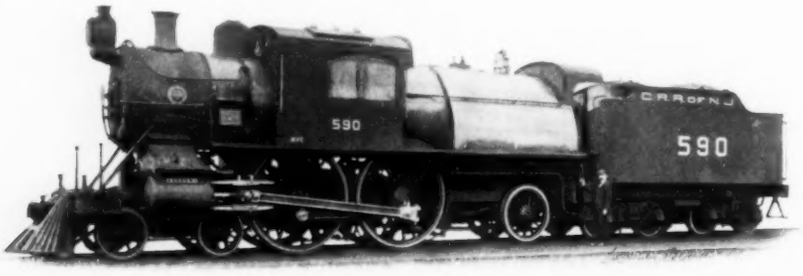


FIG. 5. 4-4-2 FINE ANTHRACITE PASSENGER ENGINE. BROOKS LOCOMOTIVE WORKS.

118.8 square feet, tubes 1,123.3, total 1,242 square feet, and grate area 17.3 square feet; second, a radial stay boiler designed for a 21x26 fast passenger engine, where an unfailing steam supply is of primary importance. This boiler has 180 square feet of heating surface in firebox and a total of 3,505 square feet, with a grate area of 50.52 square feet. This was the greatest amount of heating surface ever given a passenger engine up to 1901, when it was placed in service on the New York

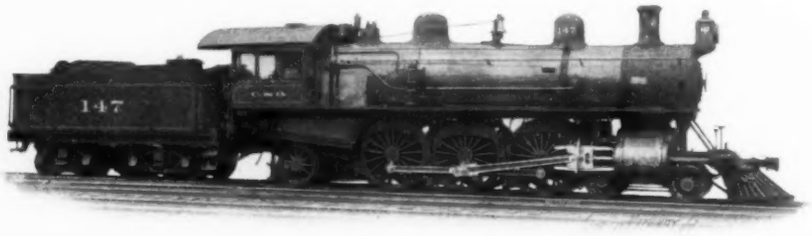


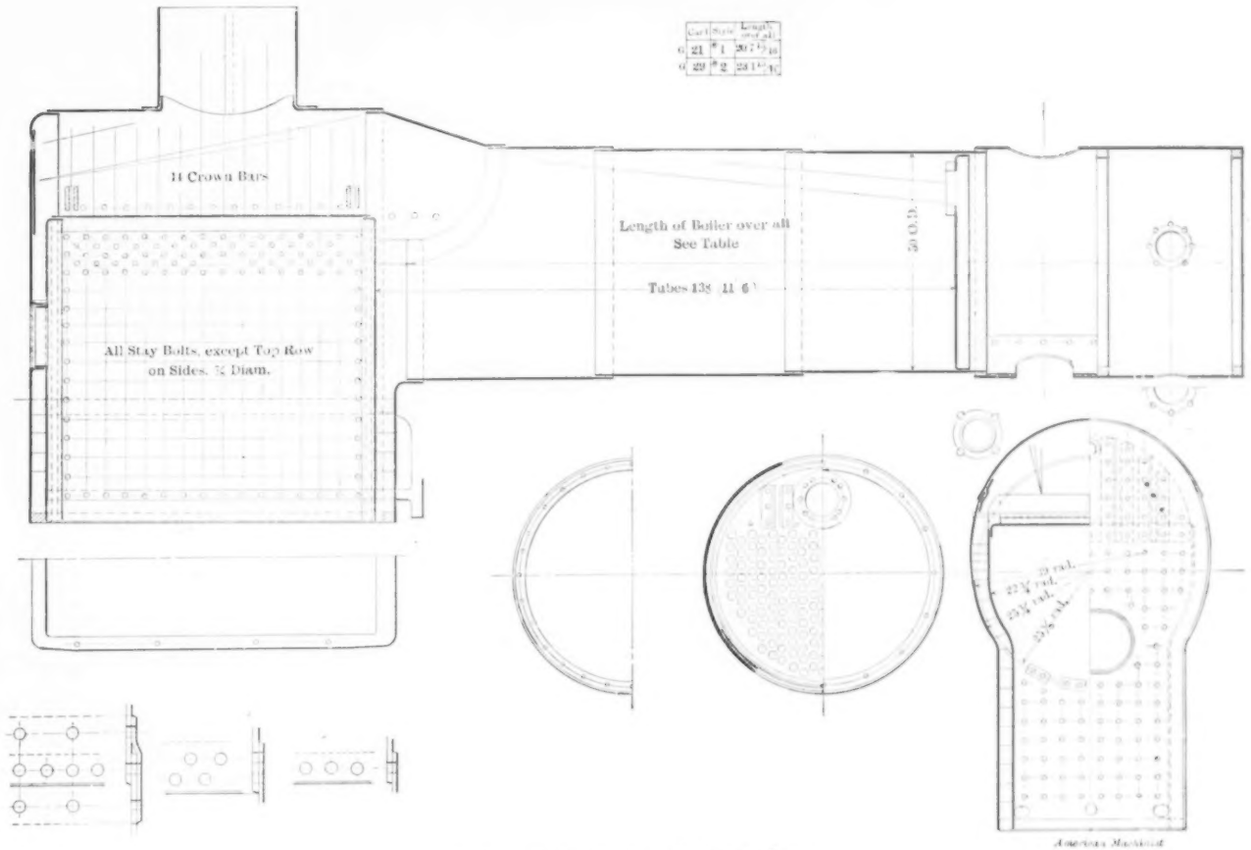
FIG. 6. 4-6-2 PASSENGER ENGINE. SCHENECTADY LOCOMOTIVE WORKS.

FIG. 7. 2-8-0 FREIGHT ENGINE. FIREBOX FOR FINE ANTHRACITE. SCHENECTADY LOCOMOTIVE WORKS.

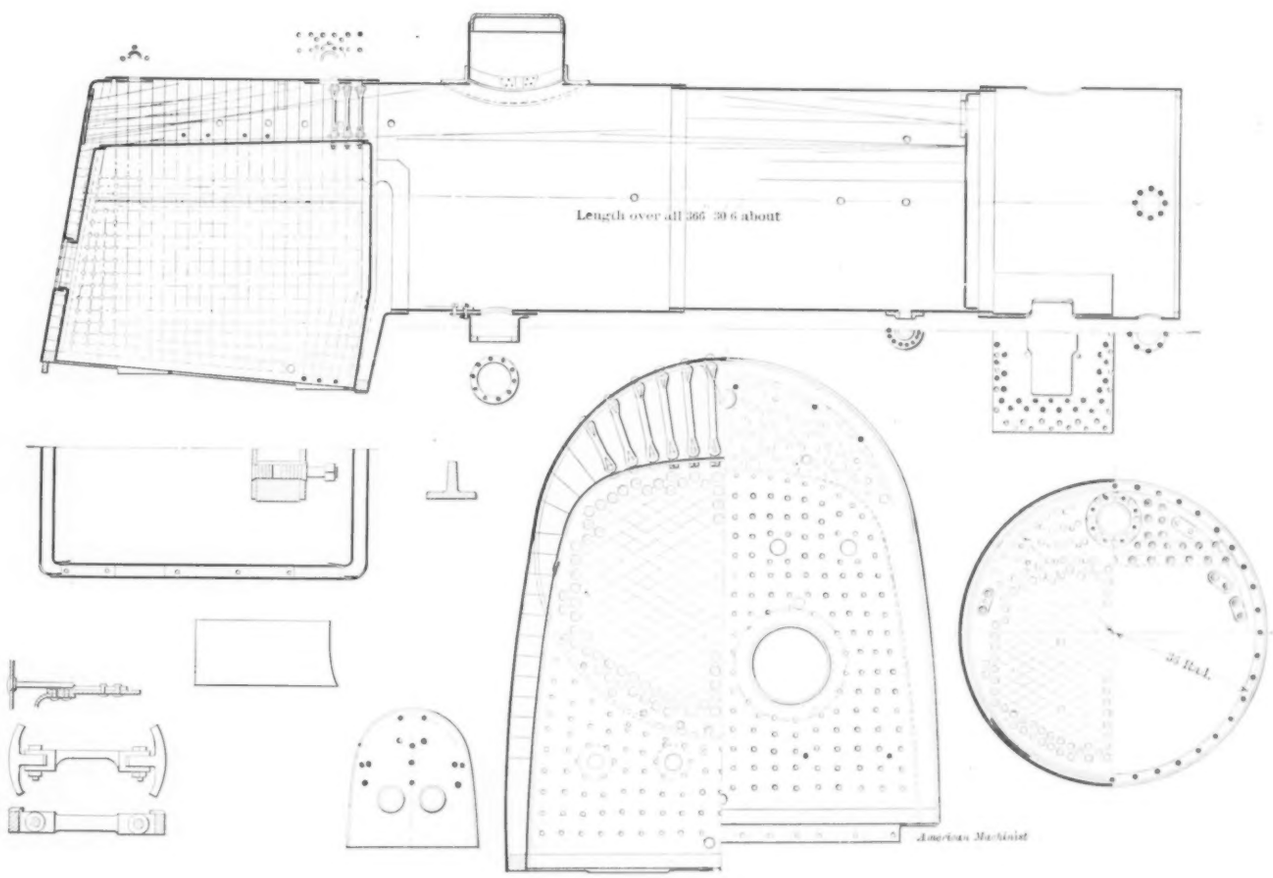
Central, and never has been exceeded for that work except by a few feet, and that by the same builders. The third, a radial stay boiler, was also built in 1901 for a 22x30 consolidation engine burning anthracite coal. The heating surface of firebox is 238 square feet, flues 3,423 square feet, and total 3,661 square feet, with a grate area of 90 square feet. The limit of heating surfaces is not embodied in the examples herewith, as that of the tandem decapod (which is the heaviest engine yet built) given in the table will show, having over 1,000 feet more than the last case cited; but these serve their purpose to indicate the tendency to increase the steaming capacity of boilers.

While the firebox is the most efficient part of the heating surface, there are limits to length and width, which, when reached, leave all additional heating surface to be furnished by the tubes. This accounts for the enormous number and length of tubes in some of the most recent engines, in some instances a length as great as 20 feet having been reached. These improvements in boilers are not the results of tentative processes, but are based on experiments which have conclusively shown an increased efficiency where a reduction in the rate of combustion is effective.

Increasing the heating surfaces has given us some new types of engines, among which is that of the New York Central referred to above. This engine has a four-wheeled leading truck, four coupled drivers and a pair of trailing wheels at the rear of the drivers. The use of the trailing truck makes it possible to increase the width of firebox to any amount within the clearance limit. It is plain that this truck occupies the place of the rear drivers on a six-wheel connected engine, and


H Crown Bars
All Stay Bolts, except Top Row on Sides, ¾ Diam.
Length of Boiler over all See Table
Tubes 138 11 6
O.D.
American Machinist

STANDARD LOCOMOTIVE BOILER OF 1877.

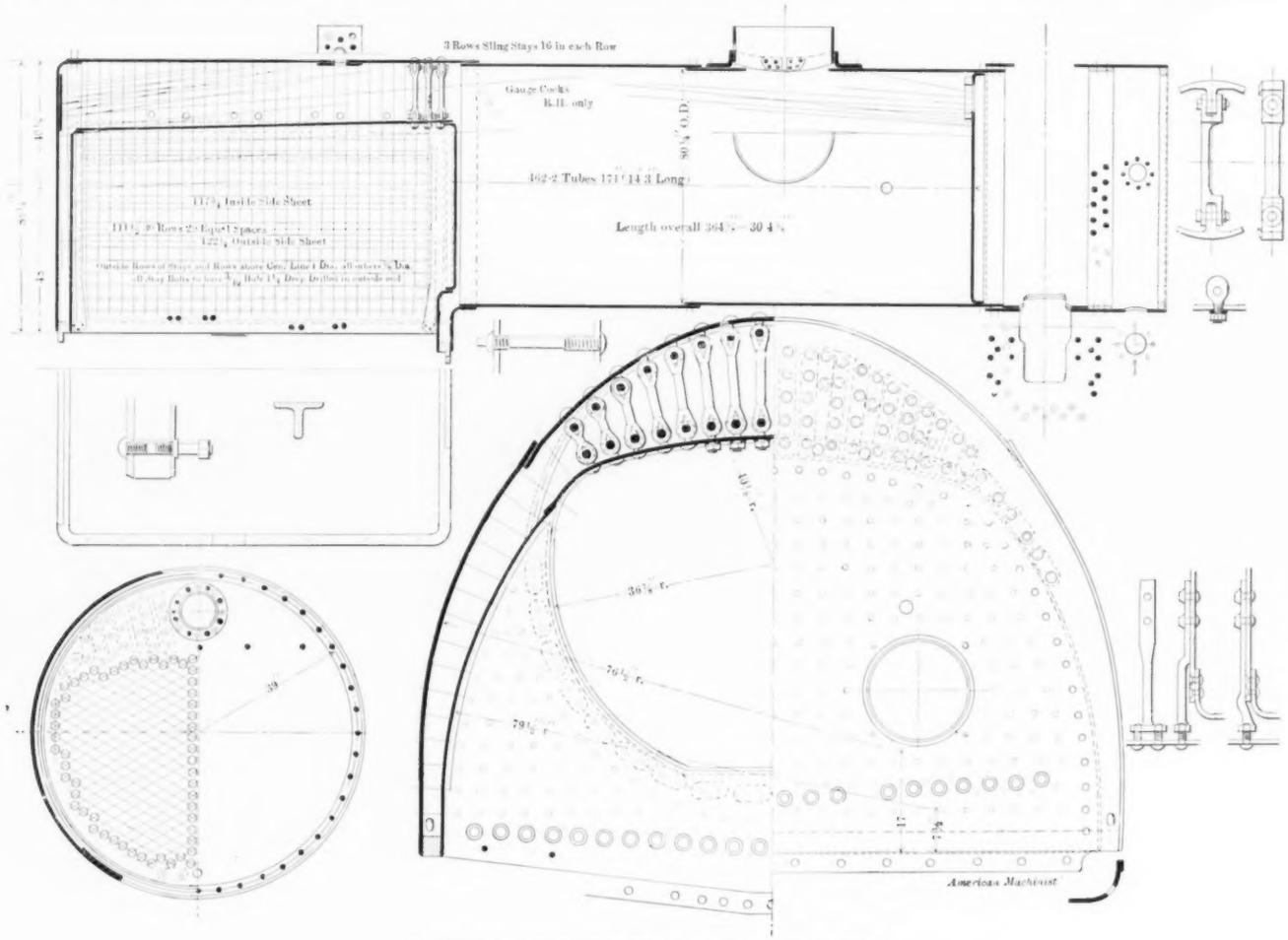


A MODERN LOCOMOTIVE BOILER.

that the weight carried by the trailer is not, under ordinary circumstances, available for adhesion. Since this weight is needed for adhesion only when starting a train, there has been what may be termed a reversion to original type, in the application of a traction increaser, a device operated by compressed air when greater adhesion is required, which throws 12,000 pounds of the trailer load on the drivers by means of a change of fulcrum on the rear equalizers. This arrangement has proven satisfactory in its operation. These engines are making a remarkable record for speed with a tonnage that is almost incredible when measured by the performance of the early engines, it being not unusual to have a load of 590 tons of engine and train, which is hauled at an average speed of 48 miles an hour. The demands of such a service very forcibly demonstrate the wisdom of having boilers that can respond to any call for steam.

FIG. 8. 2-10-0 TANDEM COMPOUND FREIGHT LOCOMOTIVE. SCHENECTADY LOCOMOTIVE WORKS.

One of the important factors entering into the problem of boiler design, and one which entails a greater weight, is that of steam pressure, which has now reached 225 pounds per square inch in some cases, while 200 pounds is almost universal practice at this time. This pressure exacts the best of material to safely confine it,



A MODERN LOCOMOTIVE BOILER WITH WIDE FIREBOX.

Type.	Cylinders. Diam.	Cylinders. Stroke.	Drivers. Diameter, Inches.	Steam Pressure. Pounds.	Heating Surface. Firebox	Heating Surface. Tubes.	Heating Surface. Total.	Tubes. Length.	Grate. Sq. Feet.	Weight—Pounds. On Drivers.	Weight—Pounds. Total.	Tractive Power. Pounds.
4-4-0	18	24	62	140	123	1343	1466	11 ft. 6 in.	17	64,000	100,000	14,900
4-4-0	20	26	78	190	175	2066	2241	12 " 5 "	30	85,800	132,300	21,530
4-5-0	2 Cyl. Comp., 23 + 34	26	78	200	187	2193.8	2380.8	14 " 7½"	35.87	133,000	174,400	23,200
4-4-2	21	26	79	200	180	3325	3505	16 " 0 "	50.52	95,000	176,000	24,700
4-4-2	05	26	85	210	174	2793	2967	16 " 6 "	82	99,400	191,000	22,944
4-6-2	22	28	72	200	182	3351	3533	19 " 6 "	47	130,500	190,000	32,000
2-8-0	22	30	54	190	238	3423	3651	14 " 3 "	90	176,000	196,000	43,400
2-10-0	Tan. Decapod, 17.5 + 30	34	57	225	205	4476.5	4681.9	18 " 6 "	54.47	232,000	259,800	55,300

and also the best of construction in the riveted work. The old boilers were almost invariably of iron, whereas those of to-day are of steel made to the most rigid specifications covering the chemical and physical properties of the material. The riveting then consisted almost exclusively of the double- or triple-riveted lap joint—now it is the butt joint with inside and outside welt strips. This is the status of boiler construction to-day, and carries its own comment in a comparison with the 140 pounds boiler pressure of the old days.

Elaboration of details in this review has been purposely omitted, but some of the accessories which have rendered the locomotive a marvel, and without which it would not be the perfect machine it is, may be touched upon. Probably deserving of first mention is the air brake, and the important influence it exerts over high speeds; the high-speed brake of to-day, with brake shoes on every wheel of engine and train, making travel as safe as human ingenuity is capable of. The bell-ringer, the fire-door opener, the ash-pan blower, the water scoop on tender and the water pressure in sleeping and parlor cars are also some of the uses to which compressed air is put, and new openings are constantly appearing for this useful medium. The electric headlight and its steam turbine, also the train steam-heating systems come far within the meaning of modern devices unknown to the older engines, and all these are no mean factors to be dealt with in locomotive design, for they each contribute their mite toward draining the steam supply.

In the presentation of half-tones of representative locomotives, it has been our purpose to deal mainly with the present; but one engine of the long-ago is shown—the eight-wheel Manchester. The others are engines of to-day, built within two years, and the table of general data gives their points of interest. The first column of the table represents the type of engine by numerals, which is in accord with the Whyte classification of locomotives, and appears to be a much more rational method by which to identify the type of an engine, than by meaningless names, since the wheel arrangement is made known at once. The numerals signify the number of wheels, the first indicating the leading truck, the second the drivers and the third the trailing truck.

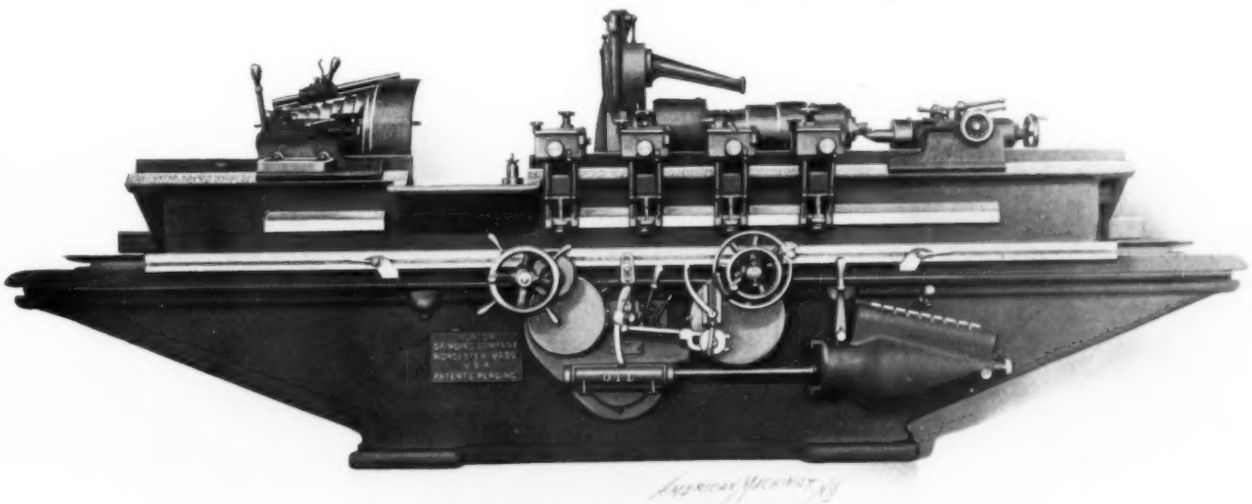
Gap Grinding Machine for Locomotive Piston Rods.

The accompanying half-tone illustrates a special gap grinding machine intended for grinding locomotive piston rods with the pistons in place and for other work having extensions or shoulders of large radius in proportion to the part to be ground. A machine of sufficient swing to clear a piston head is too large and clumsy to grind the rod well; in fact, a grinding machine of 28 inches swing cannot be made to grind a piston rod 3 inches diameter, commercially, owing to its unwieldiness. The present machine has been designed to grind rods of from 2 to 4 inches diameter and at the same time have sufficient weight to carry the heaviest pistons up to 28 inches diameter, and to swing them without weakening the supports by undue extension of headstock and footstock and steady-rests. In this machine the steady-rests are rigid and quite close to the heavy table, giving sufficient accuracy of support to allow of rapid work.

The gap table is unusually heavy to permit heavy cuts and rapid traverse of work without vibration. Rods can be ground direct, and so save turning entirely, except for the fitted ends.

With packing in sixty-fourth sizes, it is practical to increase the life of locomotive piston rods and at the same time improve their quality at less labor cost than by turning.

The swing over the steady-rests is 8 inches; in gap, 28 inches; over table, 18 inches; length between centers, 8 feet; diameter of wheel, 24 inches; width of wheel face, 3 inches. The shape of the wheel guard and wheel permits grinding close to the piston head. The width and position of gap are varied to suit the requirements. The machine shown has a gap of 18 inches wide and so located as to best care for the pistons of the railway company that are to use it. The width in this case provides for grinding slide valve stems that have yokes; the yoke swinging in the gap. These gap machines have provisions for correcting errors of straight work, but do not grind tapers. The same conveniences for rapid changes of speeds and feeds, in fact all the features of the regular machine, are embodied in this design.



GAP GRINDING MACHINE FOR LOCOMOTIVE PISTON RODS.

The machine is the product of the Norton Grinding Company, of Worcester, Mass., and it possesses the essential features of originality fully described at page 360, Vol. 24.

Thread Milling Machine.

The production of screws which shall vary within less than appreciable limits of error is probably one of the most difficult problems which come up in machine shop practice, and it directly affects the performance of most machines and instruments of precision, as well as the cost of manufacture. The production of perfect screws has been practically unattainable commercially, for the cost of production increases in a very high ratio as the permissible limits of error are narrowed.

For the production of "good" screws—that is, those which come within allowable limits of error for machine tools—the en-

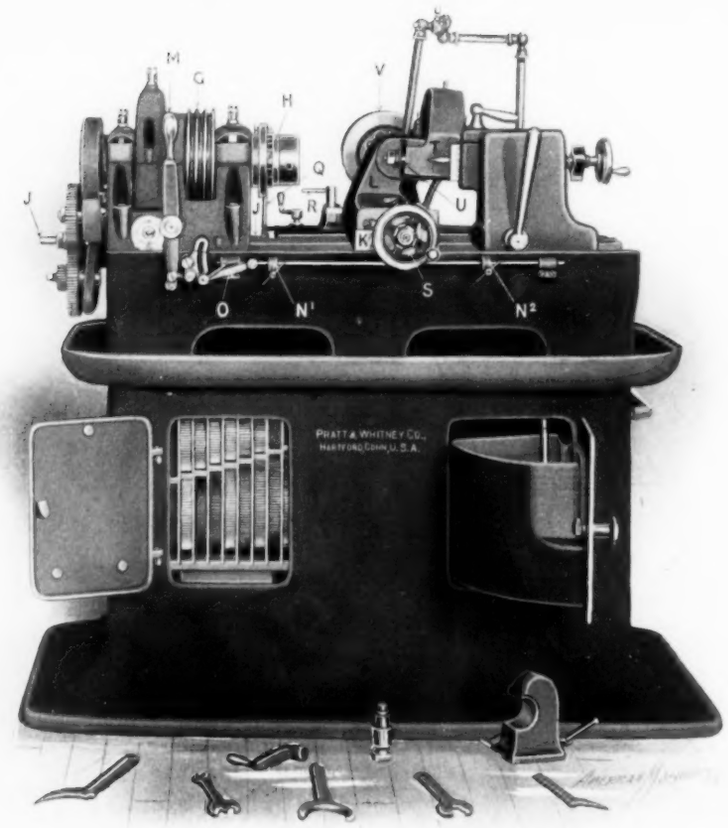


FIG. 1. FRONT VIEW OF THREAD MILLING MACHINE.

gine lathe has been universally used, and the methods employed on this do not differ substantially from those of thirty years ago. The production of a fair lead-screw on an engine lathe requires, first, a high-grade machine which should be used for no other work, and, second, the attention of a high-class mechanic. For the production of really high-grade "precision" screws, refinements entirely foreign to the practice of many shops, and beyond the experience of most mechanics, have been necessary.

Believing the time to be ripe for something better and more economical in performance than the engine lathe for the production of screws for machine tools and precision work generally, the Pratt & Whitney Company some time since took up the problem of making a machine up to such requirements, and claim to have succeeded in producing a thread milling machine possessing practically all of the flexibility and adaptability to miscellaneous thread cutting that the engine lathe possesses, and capable of doing the work within narrower limits of error than is possible with an ordinary engine lathe, and at a fraction of the cost of engine lathe work.

The machine is designed for the manufacture of precision screws, worms, lead and feed screws, and spiral gears for high-grade machine tools, and for producing more common work, such as rock drill feed screws, thrust screws for friction hoisting drums and the like, in which low cost of manufacture is a prime consideration.

DESCRIPTION OF MACHINE.

Referring to Fig. 1, the bed and pan will be seen to be made in a single casting, in order to increase the stiffness of the former without increasing the weight of the machine as a whole.

The headstocks and tailstocks are carried on a single "V" at the rear, and a flat track at the front of the machine. The carriage *K* rests on a flat track at both the front and the rear of the machine, and is gibbed in a narrow angular slide at the rear. Lifting of the carriage by the upward thrust of the cutter is prevented by a long, flat gib underneath the flat track at the front of the machine. The lead screw *J* is in the center of the angular carriage slide, giving a direct pull to the carriage.

The milling cutter arbor is mounted in a head *T* connected to the cross-slide *L* on the carriage *K* by trunnions, which allow it to be tilted to any required angle for a given pitch of thread. The center of the cutter *U* is in the same horizontal plane as the center line of the screw to be cut, and in the same vertical plane as the center line through the trunnions. Thus, no matter through what angle the cutter may be turned, the point of the cutting tooth is always level with the center line of the work. To provide means for setting the cutter properly for any given thread, one

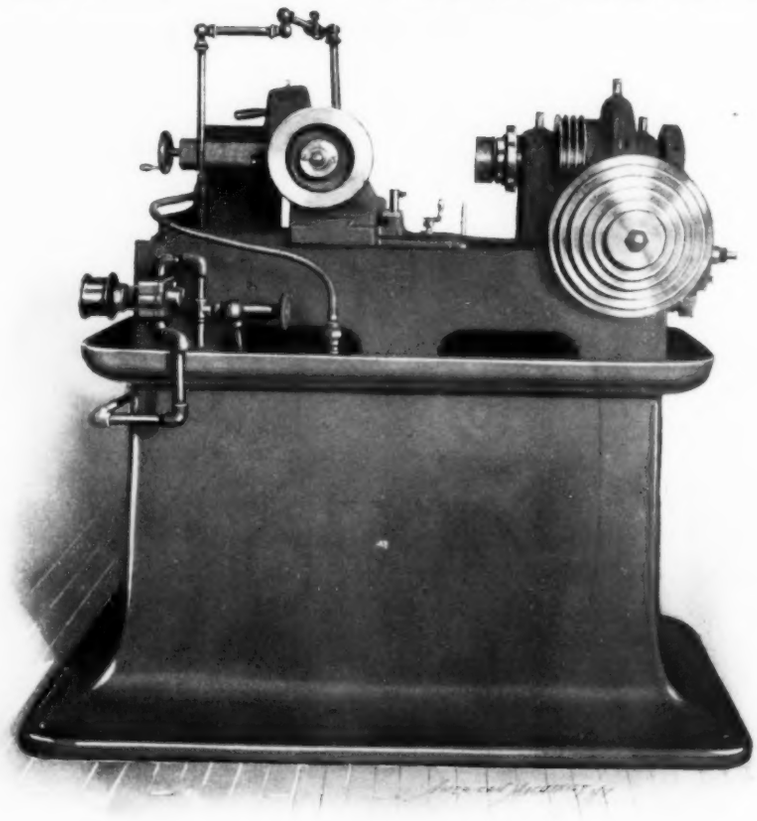


FIG. 2. REAR VIEW OF THREAD MILLING MACHINE.

of the trunnions is graduated, and a table of angles is furnished giving position of cutter head for all pitches of threads within the capacity of the machine.

Provision for making the cut the correct depth for a given thread or gear tooth is made by a micrometer head S on the cross-slide screw in the carriage. The work being finished to size for the outside of the required screw, worm or gear and placed in the machine, the cutter is brought forward by the cross-slide screw till a tooth of the cutter just touches the work, and the micrometer is set to zero. The carriage is then moved along the bed till the tooth clears the end of the work, the cutter is brought forward by the micrometer cross-feed screw to the correct depth, as shown by a table accompanying the machine, and the cross-slide is clamped in this position. Then with the proper change gears in place for the required pitch, and the stop N^1 (assuming the cut to be made towards the headstock) set for knock-off of feed at the required point, the machine is ready for operation and needs no further attention beyond removing the finished piece and replacing it with a new blank.

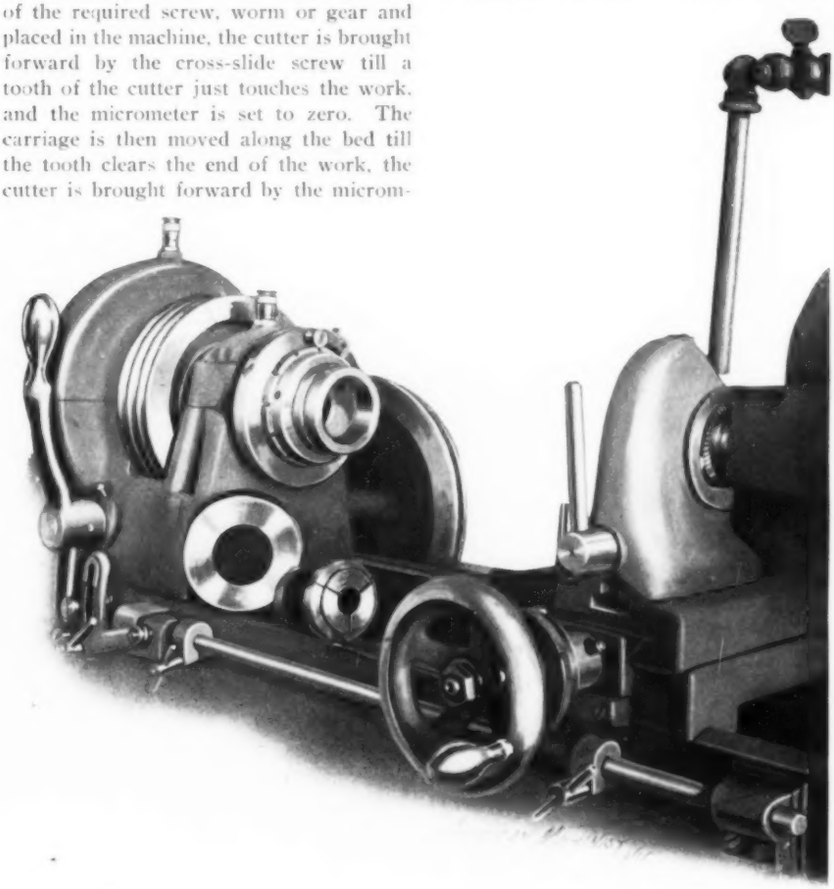


FIG. 3. NEAR VIEW OF HEADSTOCK AND COLLET.

The carriage K can be moved along the bed independently of the change gears by turning the small crank at the back of the carriage, which crank, through a worm gear, revolves the lead-screw nut. Thus it is easy to set the cutter to begin the thread at any desired point, or to reset the cutter in its proper place, should it at any time be necessary to withdraw it from the work. When the carriage is properly located the nut is locked in position by the lever Q at the end of the carriage, independently of the worm above mentioned, so no movement of the carriage can take place except from the lead screw alone.

LEAD SCREW CHANGE GEARS AND FEED MECHANISM.

The machine is regularly equipped with an English lead screw having 6 threads per inch and change gears for cutting threads from 20 per inch to 4 inches pitch, including 11½. It is also furnished with a metric lead screw of 4 mm. pitch, and either the English or the metric screw is fitted with translating gears, to enable metric threads to be cut with English screw or *vice versa*. For cutting threads of over 2 inches pitch and spiral gears, a lead screw of coarser pitch than that regularly furnished for cutting ordinary threads is advised. The machine is so constructed that a change from one lead screw to another can be quickly made.

The travel of the carriage is controlled by the lever M on the front of the headstock. With this lever in its central or vertical position the feed is thrown out; when pushed to the left the feed is thrown in, and when to the right the carriage is returned to the initial end of the cut. This latter movement is at relatively fast speed, being driven by belt on the grooved pulley G. During the cutting operation the pulley G runs loose on the spindle, and the work

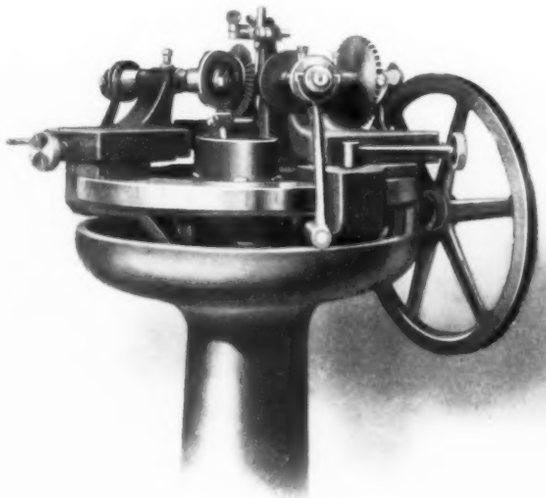


FIG. 4.

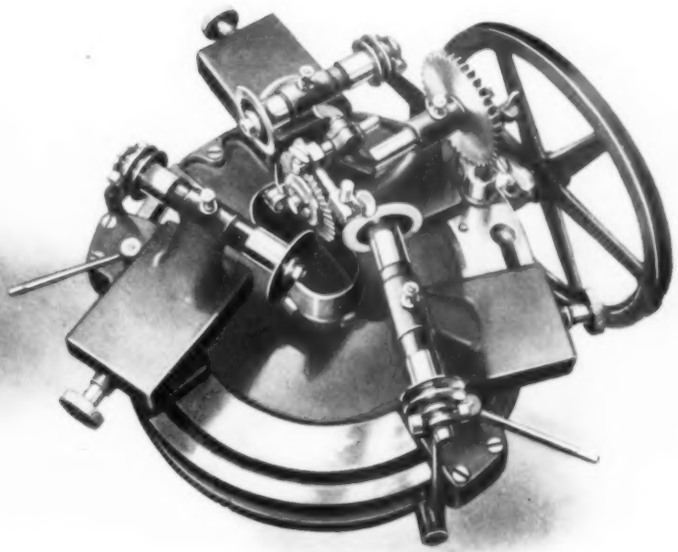


FIG. 5.

THE CUTTER GRINDER.

is driven by the cone pulley shown in Fig. 2.

When threads of steep pitch, say, 1 inch lead and upward, are to be cut, the carriage should be returned to the initial end of cut by hand, the lead screw *J* being squared at one end for a crank for that purpose.

The engraving shows the machine set up for cutting right-hand threads. To cut a left-hand thread it is only necessary to put an idler gear between the spindle and the

FIG. 6. SAMPLES OF WORK.

lead screw, change the driving side of the belts, which drive the cutter and spindle, and turn cutter head *T* over to the opposite angle.

When for any reason it is desired to cut towards the tailstock, this may be done by reversing the direction of rotation of the lead screw and by connecting the link *O* to the upper end of the pivoted arc and setting the stop N^2 to knock off the feed at the desired point.

MULTIPLE THREAD AND SPIRAL GEARCUTTING.

Indexing for multiple thread and spiral gear cutting is a very simple operation. A compound spindle, consisting of an outer hollow spindle which carries the driving mechanism and the spindle gear and an inner hollow spindle carrying the nose-piece and collet are employed; the inner spindle carries a notched index ring *H*, shown more clearly in Fig. 3, and the outer spindle carries a pawl which normally locks the two spindles together. To index the collet end of the spindle for a given thread it is only necessary to release the pawl from the notch it may be in, and turn the inner spindle through such a fraction of a revolution measured on the notches, as 1 is of the multiple thread or the number of teeth in the gear to be cut, and let the pawl fall in place again. Thus to cut a triple thread, using a 12-notch index ring, the inner spindle carrying the pawl would be turned four notches, or one-third of a revolution for each thread.

The belt system has been very carefully worked out to provide against all contingencies in the way of accidents to the cutter and consequent spoiling of work, and at the same time to provide a range of feeds to cover all sizes of stock within the capacity of the machine.

Six round belts are used for driving the cutter in place of the ordinary flat belt. These belts in united driving power are equal to a 3½-inch flat belt, and have such an excess of driving power over that required for the work that any two may be broken without affecting the operation of the cutter. This is an important feature, as, should the cutter driving belt fail entirely, as a single flat belt would do if it failed at all, the cutter and the work would both be damaged before the machine could be stopped. The cutter driving pulley is shown at *V* in Fig. 1.

SPEEDS AND FEEDS.

Ample provision for varying the rotative speed of the work is made. The grooved cone pulley has six steps, and as the belt will drive successfully on the step next below that directly corresponding to the step on the driving cone, and *vice versa*, sixteen changes on the round belt cones alone are available; these, combined with the two changes on the countershaft and the two other changes possible on the two-grade friction cone on which the main driving belt runs, make sixty-four changes of speed available, covering a range of rotative speeds on work from ¼ to 5½ revolutions per minute.

Ordinary machine-tool feed and lead-screw threads can be cut with a lineal advance of the cutter in the thread (measured around the screw) of 3½ to 4½ inches per minute, within limits of error of .001 of an inch per foot of length of finished screw. Screws of medium pitch, cut from soft material, but in which extreme precision is not necessary, can be cut at a still higher speed, while for precision screws of very coarse pitch or heavy tooth spiral gears a slightly lower speed may be advisable. In this, as in all other milling operations, good judgment on the part of the operator is a factor in determining the maximum capacity of the machine, but the figures quoted were given to us as safe figures on which to base estimates of capacity.

THE CUTTER BACK REST AND COLLET.

The form of milling cutter used on this machine in milling threads has its teeth staggered, as shown in Fig. 6—that is, each tooth, with the exception of a single one, has but one cutting edge, these cutting edges alternating in successive teeth. One is left a full tooth for the purpose of gaging. These cutters, we are told, can be run twenty-five to thirty hours on ordinary work without regrinding. By the use of the special automatic grinder, shown in Figs. 4 and 5, sharpening the cutters is a simple matter. For cutting spiral gears, regular gear cutters are employed.

When screws of comparatively small diameter are to be cut so there would be a possibility of springing the work between the centers, a back-rest *W*, Fig. 1, with interchangeable bushings for various diameters of work is used.

One of the collets used is shown in Fig. 3, the capacity of the largest being 2 inches. The collets are held in place by a nose-piece, also shown in Fig. 3, and which serves as a closer.

WORK OF LARGE DIAMETER.

For work larger than the regular collet capacity of the machine—that is, above 2 inches diameter—a special face-plate and solid collet with live center are provided. This collet is put in place of the regular collet and carries the live center, making in effect a solid spindle end. The face-plate is screwed on in the place of the regular spindle nose-piece, holding the solid collet in place, and has provision for tightly clamping the tail of the lathe dog used on the work, and preventing any looseness of parts or back-lash. The capacity of the machine is thus extended to 6 inches, the use of this face-plate in no way interfering with the functions of the index-ring in multiple-thread or spiral gear cutting.

THE SPECIAL CUTTER GRINDER.

Figs. 4 and 5 show the special automatic cutter grinder which has been designed for grinding the cutters.

The cutter is mounted on an arbor supported above a circular base, and adjustably mounted on this base are three grinding heads, the spindles of two of which may be set at any desired angle to the cutter arbor by graduations on the base, while the spindle of the third is parallel to the cutter arbor.

The two adjustable grinding heads are for grinding the angular faces of the cutter; the grinding head, which has its spindle parallel to the cutter arbor, is for grinding the faces of the teeth.

Each of these spindles has a reciprocating motion when at work, slightly greater than the longest face of the cutter it will be called upon to grind, and the full length of each cutting edge is traversed twice by the wheel. The reciprocating movements of the spindles which are at an angle with the cutter arbor alternate with each other, so that interference of the two wheels is impossible.

All the grinding heads are adjustable on the circular head of the machine to provide for the variation in sizes of cutter used.

In the grinding operation the cutter is automatically indexed after each two passes of the wheel over the edge being ground. Thus the machine needs no attention after the cutter is placed on its arbor and the grinding heads are adjusted to bring the wheels to the proper position for grinding the cutter.

A table is furnished showing the correct angle for the cutter tooth for each pitch of thread for all pitches and principal diameters of screws within the capacity of the machine. These angles may also be determined by special gages.

GRINDING CUTTER FOR CORRECT ANGLE OF THREADS.

It will be understood that while it is no more necessary in the run of ordinary work to grind the cutter to the *theoretically* correct angle for a given diameter of screw than it is with threading tools used on a lathe, this grinding machine with the table of angles above referred to provides a ready means of introducing this refinement when it is desirable. The error due to the angle of the thread with the axis of the screw is more apparent on steep pitch threads than on ordinary threads, increasing as it does with the lead of the screw. This table permits this error to be corrected for all pitches and diameters. While the graduations on the head of grinder provide means for setting the emery wheels to produce these angles, fixed gages are considered preferable when extreme precision is important. These gages are also necessary for testing tools for threading nuts to be used on screws cut with such specially ground cutters.

EXAMPLES OF WORK.

Fig. 6 shows general samples of the work, which speak for themselves as far as variety is concerned. The lower part of this illustration shows several *springs* which have been made from steel tubes, the cutter being set to cut through the body of the metal. A unique feature of these springs is that they are integral with the solid ends, and for high-class work in

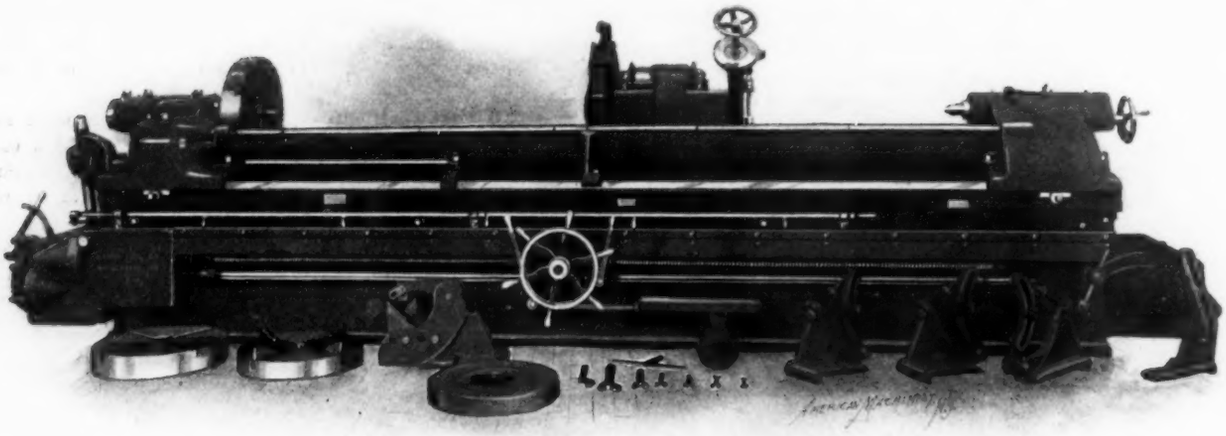


FIG. 1. FRONT VIEW.

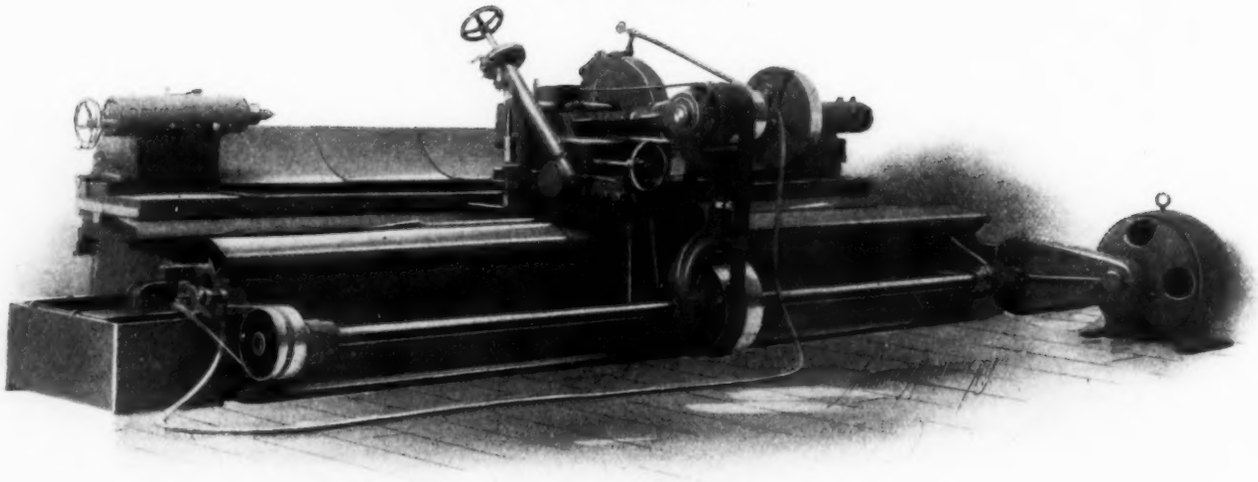


FIG. 2. REAR VIEW.

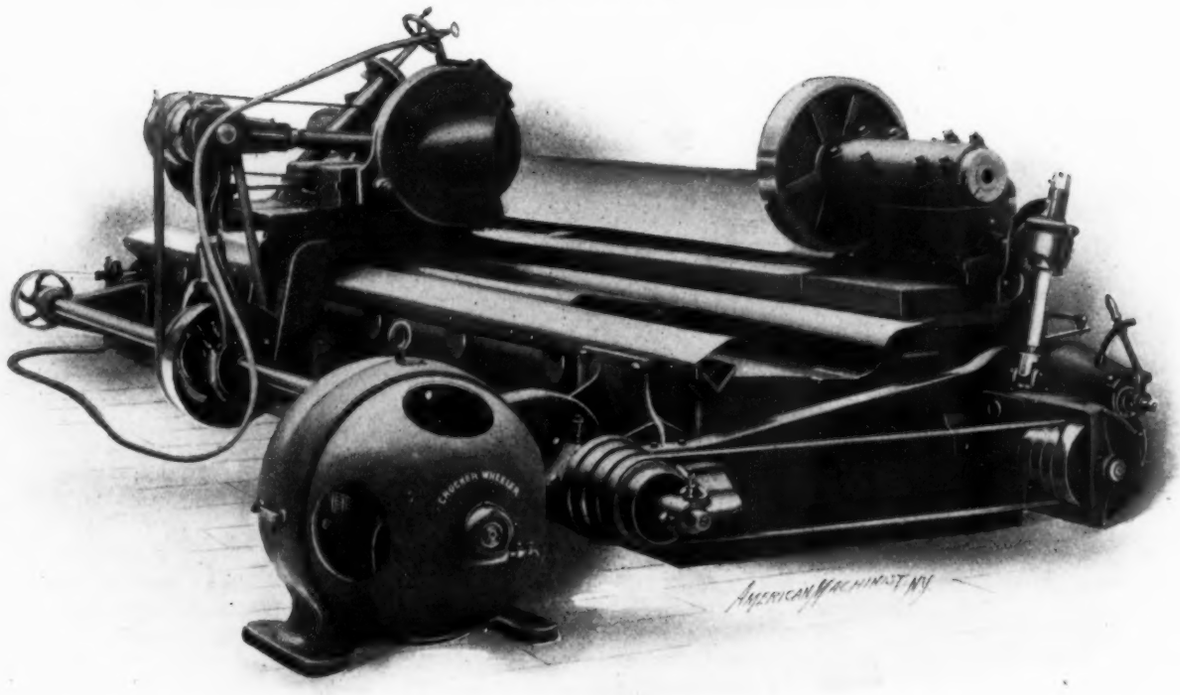


FIG. 3. DIAGONAL REAR VIEW.

HEAVY AUTOMATIC GRINDING MACHINE.

which this is important in order to prevent the tendency of helical springs to cock sidewise, this machine is considered to offer an advantageous method of manufacture.

The machine is made in two sizes, which, however, differ only in the length. The extreme diameter of screw which can be cut is 6 inches, and the length 15 and 78 inches respectively.

A New Heavy Grinding Machine.

The accompanying illustrations show the most recent product of the Landis Tool Company, of Waynesboro, Pa. It is classified as a semi-universal, self-contained machine, by which is meant that it does not contain all of the adjustments of the universal machines and that it does not require overhead works. It is arranged with a swiveling headstock which has an adjustable spindle bearing and is provided with a face-plate and chuck with which work can be ground at all angles from 0 to 90 degrees. An internal grinding attachment is also fitted, when wanted, so that straight and taper holes can be ground. The headstock spindle can be locked and the work rotated on dead centers by a loose face-plate in a similar manner to the smaller machines. The swiveled head is doweled for straight line position with two tapered pins, and is secured to its base by three bolts engaging a circular tee slot.

The interior of the headstock is fitted with bevel gearing which is arranged concentric with the swivel pivot, and by it the power is transmitted to the work driving arrangement at all angles. A shaft extending from the end of the swiveled table of the machine to some distance toward its pivot passes through the base of the stock, as shown in Fig. 1. This shaft is splined and on it a gear is mounted, permitting the head to be moved to different positions as required. A lever on the front of the headstock is arranged to engage and disengage the gearing from said shaft by a clutch for the purpose of stopping the work independently of the traverse, which is often desired.

The footstock spindle has an adjustable bearing, and is arranged to be clamped. It is operated by a screw which is back geared to a hand wheel. Both headstock and footstock are arranged to be positioned on the table by a rack secured to the latter and a pinion on each stock which is operated by a detachable crank.

The emery-wheel base is fitted with a heavy spindle with adjustable journals 4⅞ x15 inches and 4x10 inches, and carries an emery wheel 30 inches diameter by 1½ and 2 inches wide. The emery-wheel pulley, 14 inches diameter for 4½-inch belt, gives ample power capacity for doing rapid work. The emery-wheel base is adjustably mounted on a slider which works on a lower slide.

Power for driving the emery wheel is transmitted through a grooved shaft running the whole length of the rear side of the machine, as shown in Figs. 2 and 3. A pulley, trunnioned in a bracket secured to the emery-wheel carriage, passes back and forth over the shaft and is driven by the grooves in the shaft through wheels which make a practically frictionless travel. A vertical yoke, carrying an upper intermediate shaft and pulleys, serves as a joint to another yoke connecting with the emery-wheel base. This makes a complete connection between the lower shaft and the emery-wheel spindle and compensates for the movement of the emery wheel to and from the work, keeping the belts under driving tension. Both yokes are provided with screws to lengthen them in order to tighten the belt as required. It will be noticed that with this driving mechanism the pull of the belt causes no pull upon the carriage guide nor against the wheel feed-up device, as the belt pull is all taken up by the yokes. This leaves the carriage free to move and to carry nothing but its weight and the grinding cut.

The emery wheel carriage runs in guide ways on the bed, which are scraped to surface plates. These guides are protected their entire length by metallic covers, as shown in Figs. 2 and 3.

From the rear shaft, at the headstock end, motion is transmitted to the gearing for rotating the work and traversing the emery wheel carriage, as shown in Fig. 3, by a loose cone pulley on the rear shaft, which is secured when wanted to drive the work and feed by a friction clutch. This clutch is operated by a rod on the front of the machine, shown in Fig. 1, making it convenient to stop and start the work from any position of the operator in front. The cone pulley connects to the gearing by a belt for changing the speed of the work. The feeds, in this instance remain constant with relation to the rotation of the work, except that when a greater variation than these cones will make is desired, a change is made in the headstock by a lever on the gear box at the left-hand or headstock end of the machine, Figs. 1 and 3, by which cone gears, arranged for proper speeds, are positively clutched to the shaft, giving five changes of feed from 3-16 to 2 inches per turn of work. Four changes of work speed are obtained by the cone pulleys and a back gear makes four more, which, added to the changes made in the headstock, give in all sixteen changes of work speed, covering a range from eight to 200 turns per minute.

A hand-wheel carriage, Fig. 1, on the front of the bed traverses with the emery wheel, and on it a lever for starting and stopping the traverse feed and another for reversing the motion of the carriage by hand are located, and also a hand-wheel by which the carriage can be moved by hand a limited amount. This hand-wheel has a clutch, so that it can be disengaged when feeding by power, to prevent its turning. To this carriage is attached a platform which is mounted on wheels and is carried back and forth. On this the operator can stand to look over his work, which, owing to the size of the machine and the work that can be executed on it, is necessary.

The table, on which are located the headstock and footstock, is pivoted at its center, enabling tapers up to 2 inches per foot to be ground. A graduation on the end of the table gives readings by which it can be set. It is firmly clamped at four points in its length. The universal couplings on the vertical shaft at the left-hand end of the machine compensate for this swiveling movement.

The cross feeds are automatic, the range being from .00025 to .008 inch at each reversal of the carriage.

All gearing will be seen to be covered, insuring safety to the operator as well as preventing the entrance of dirt.

This machine is also built with a plain fixed head, making a plain grinder suitable for grinding shafts on their centers, both straight and taper.

Power can be applied to the shaft by a belt or by an electric motor coupled with a driving chain, as shown in the illustration.

26″ Rapid Reduction Lathe.

Those who are accustomed to looking ahead a little think they see, as one of the developments of the near future, the practice of building certain machine tools exclusively for taking roughing cuts, the finishing to be done by other tools—cutting or grinding as cirucmstances may demand. The recent development of the so-called high-speed cutting steels has given this tendency a fresh impetus, and we illustrate herewith a lathe specially designed and built for such work. In describing this lathe we probably cannot do better than to quote from a letter written by its builder, which letter, though not intended for publication, gives a good idea of the object sought to be attained and of what the lathe is capable of. The writer in his letter says:

"The introduction of tool steel capable of working at high cutting speeds in our shops brought out the fact that the lathes which we were using, and which had been considered abundantly strong and powerful, were incapable of utilizing the new steels to their full advantage. Increasing the belt speeds did not secure the desired results, demonstrating to our satisfaction that the machines designed for cutting speeds of from 25 to 30 feet per minute could not be expected to work at cutting speeds of from 75 to 100 feet per minute, particularly if the amount of feed and depth of cut were to be retained.

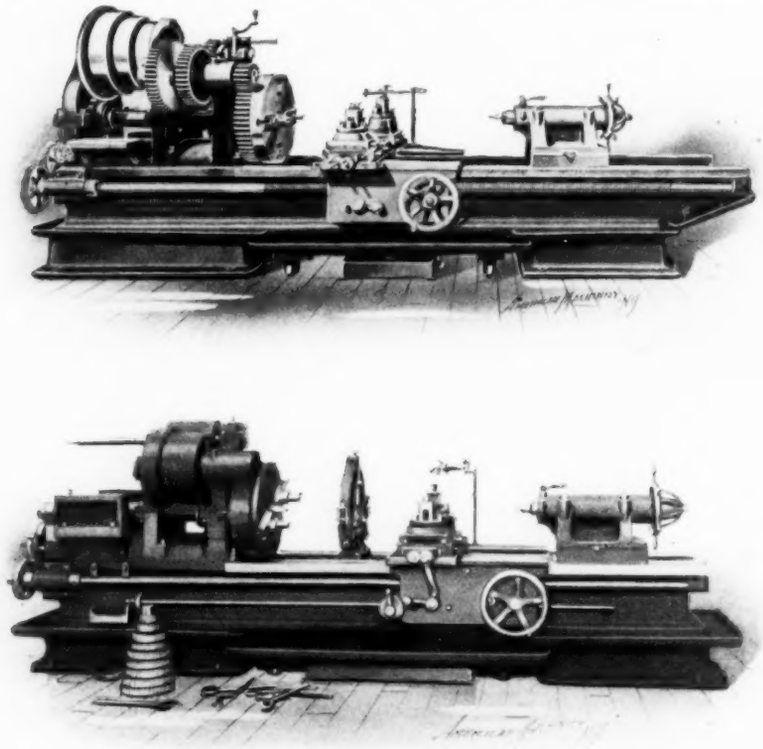
"We were also convinced that radical departures would have to be made in the general design and all elements of weakness eliminated. We therefore developed this lathe and are pleased to say that it

surpasses our expectations, both in the amount of work produced and in the ease with which it withstands the heaviest cuts at these high speeds.

"We believe that the cutting tools have a much longer life with a heavy machine than with a light one, and the fact that the writer has seen tools in use at speeds varying from 100 to 150 feet per minute, which did not require grinding more than once every fifteen hours, would tend to prove this theory.

"A number of these lathes which are in use at a large electric shop are producing motor shafts at from one-fifth to one-tenth of their former cost. Cuts which were considered impossible two years ago are an accomplished fact.

"The headstock spindle is face-plate



RAPID REDUCTION LATHE.

driven at all times and has two changes of gearing; the gears being slid into mesh by rack and pinion instead of by the eccentric shaft usually employed for this purpose. This construction maintains a fixed center distance and avoids all possibility of the gears throwing out under heavy loads. All gears are covered as shown.

"The difficulty of securing satisfactory lubrication led us to adopt ring-oiling bearings throughout the headstock—large chambers under each journal being the source of supply.

"An equalizing driver is incorporated in the face-plate, which permits of the use of double-tailed driving dogs.

"The demand for electrically driven tools being great, we made a special effort to construct this headstock so that it might be either belt or motor driven, as required. When belt driven, a cone pulley having steps 18, 21 and 24 inches in diameter, for 6-inch double belt, is mounted on the primary driving shaft. When motor driven, a 20 horse-power variable speed motor is required; the speed variations corresponding with those obtained by the cone pulley and countershaft—the motor replacing the cone shaft. Ample space is allowed for attaching any make, size or type of motor.

"The bed is exceptionally wide and heavy, and has flat shears which permit of a large bearing surface for the carriage. V's tend to weaken the carriage or else decrease the swing over the carriage. The carriage has both front and rear tool slides which equalize the strain on the centers and which can be operated both together or independently—the front slide having a lateral adjustment for dividing the cut between the front and rear tools. The tool holders take stock 1½x 2½ inches.

"After carefully considering the question of feed mechanism, we decided that a lead screw of large diameter, connected with the main spindle by heavy change gears and engaged in the apron with a lock nut, would best meet the requirements of high-speed turning, in that it offered an extremely strong construction with absolute uniformity and reliability of motion. It was therefore adopted and in use is found to be all that could be asked. It can be engaged and disengaged under the heaviest cuts more readily than can a friction. We also gave considerable study to the best place to locate this screw and finally placed it, as shown in the cut, well under the wing of the carriage where it is not exposed to chips nor any foreign substance and yet almost as close to the line of strain as if placed in the center of the bed.

"We are also prepared to put on these machines a quick power traverse for the carriage, which will relieve the operator of the necessity of running the carriage back and forth by hand. The controller handle is also attached to the apron, as shown in cut of the motor-driven machine.

"The footstock is extremely heavy and is movable on the bed by rack and pinion.

"Provision has been made for a copious supply of cutting lubricant—from four or five gallons per minute—being passed over the work and tools. The pans, which entirely surround the machine, all drain into a central tank. We find that this feature is almost a necessity, the cutting tools having a much longer life when properly cooled, and excessive heating of the work with consequent expansion between centers being avoided. In general, will say that the main idea has been to make a machine capable of the most severe duty, yet having the facility of operation which has become a necessary feature of the modern engine lathe.

"We wish to call your particular attention to the weight of this machine—a 16-foot bed weighing about 17,000 pounds. Our previous 26-inch engine lathe (which was admitted to be exceptionally heavy) weighed but 9,000 pounds for the same length of bed."

The lathe is built by the Bullard Machine Tool Company, and we show it in two different forms, one to be driven by belt, the other by motor.

Letters From Practical Men.

The Invisible Plan of Progress.

Editor American Machinist:

Concerning the great advance in machine shop methods, in quality of product and in speed of outputting, which a retrospect of a quarter of a century enables us so clearly to see, there is one most noticeable phase of it which, though so evident, may not find adequate appreciation nor receive the mention it would seem to deserve.

No man planned the work. In the year when the first copy of the AMERICAN MACHINIST saw the light there was no one anywhere foretelling what would be done in the next quarter of a century, no one suggesting in a large way what should be done; indeed we know full well there was no one who could have played the prophet nor any who could have assumed the direction of a movement so vast.

Looking back now and contemplating as a whole our work thus far completed, and the manner of its doing, we can see that

those who have been most helpful, those most prolific in their accomplishment, have still wrought only on the details of the work, with no clear knowledge of the relations and interdependencies of the several parts in the ultimate grand assembling. While the myriad of thinkers and workers have been shaping and polishing each his little piece and placing it upon the pile of finished work, the great whole has arranged itself, or has been guided and impelled in the arranging by agencies of which we have not been conscious, and of which we have had no tangible evidence except in the completeness and perfection of the result.

This is as it has always been. It is not an exceptional thing, though frequently remarked as such, to build better than we know, and it is, in the perfection of the result, in no sense attributable to any latent or unconscious wisdom which, after the fact, we may complacently claim to possess. When we are doing good work, and know that it is good, we still generally do not know how it is related to the good work that others are doing, nor how each man's work will fit so perfectly into that of the other, and each strengthen and quicken the other to the betterment and continual upbuilding of the symmetrical and consistent whole.

As it would have been utmost folly anywhere in the past to have attempted to have discovered and deciphered and studied out in advance some comprehensive plan of the work of the year or the decade or the quarter of a century immediately before us, with the hope of lightening or simplifying our task and of avoiding serious mistakes and backsteppings, so it would be as great unwisdom now to try to do so. While by the results a plan seems evident enough, we know nothing more surely than that we do not know, and never have known, and never can know, what the plan is until the work is done.

This absence of plan is indeed a plan in itself. The way of running the great shop of the universe seems to be, after all, just the same as experience shows to be best for running the small shop, or indeed the shop of any size up to the capacity of the individual human mind to direct. The shop is kept at all times as clear as may be of all but what at the moment concerns and gives occupation to the workers. The beneficence and economy of this are evident. We, the workers, are not to be fatigued except by the actual doing of the work, and not at all by any preliminary contemplation of it. We are not to be disheartened by the piling up around us of any work to be done far in the future. Our minds are not to be distracted to look over plans other than those which have to do with the work of to-day; we have not to be stumbling over nor walking around any material upon which another generation is to do the cutting and shaping.

While thus we see no plan before us, but behind us see it plain enough, that in itself sufficiently assures us of its continued unrolling as we reach it. While we need not trouble ourselves to know what we will have to do when the fiftieth volume of the AMERICAN MACHINIST is completed, nor what we will be doing for the filling of any volume beyond that now current, we may still be sure that there will be a plenty of work to be done, that it will be done in the same general way as heretofore, that it will be work to be proud of when we look back upon it, and that it still will all be contributory to the general and unceasing advance.

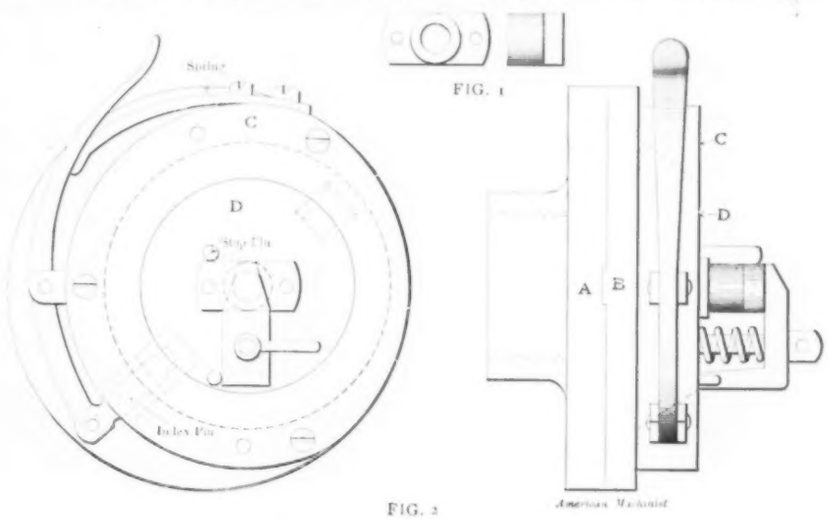
Besides the absence of cognizable preliminary plan there is another feature of our latest quarter of a century of completed work which it may be well perhaps to think over a little, and that is, the character and caliber of the workers. It certainly should not be necessary for me to say that by workers I mean not those who work with hand alone or with head alone, or with either hand or head preponderating. I mean by a worker every one who has done or helped in the doing of any of the good work that has been done. It is not so easy nor so safe to speak of the workers as of the work, for here differences of opinion at once arise. There are inevitably some who attain greater prominence and a larger reputation than others, but it seems to me that in the period we are considering those most conspicuous ones were never so few and far apart. Notwithstanding the vastness and the excellence of the work that has been done, we cannot point to many men so towering above their fellows as in periods preceding. Watt, of course, stands alone as a unique genius with a unique opportunity, but after him come many names which the world has decided not to forget. Whitney, Blanchard, Whitworth, Nasmyth, Armstrong, the Brunels, Morse, Faraday, Goodyear, Bessemer, Siemens, Howe, McCormick—these are a few hastily thought of, with little regard to chronology. In our own time, leaving out Edison, another genius with a special opportunity in the electrical field, we seem to look in vain for names which will stick in the world's recollection with these. This may mean either of two very opposite things—that there are no such exceptionally gifted and self-impelled workers in these days, or that there are so many of them that none can be so conspicuous. Undoubtedly the latter is the truth, and it is far from discouraging to the rank and file of the industrial army. More work actually done and fewer workers doing disproportionately large shares of it means a larger average of work all around. The individual worker, whoever he may be, is of more account, or greater in accomplishment, than ever before. Many undoubtedly stand as high as the highest of the past, but those around them are taller. "There were giants in those days," and there are giants still, but it is no longer pigmies that immediately surround them.

TECUMSEH SWIFT.

A Screw Machine Drilling Fixture.

Editor American Machinist:

The description and accompanying sketch explain the method of drilling the small holes in the piece of work, Fig. 1. It was necessary that the holes should be a certain distance from the center hole and exactly in line. The first method of drilling them was in a drill press jig, which, however, did not prove satisfactory.



SCREW MACHINE DRILLING FIXTURE.

The fixture here described is, and has been for some time, in operation, and gives good satisfaction. The face-plate *A*, Fig. 2, has a groove cut in the center and the plate *B* is fitted to *A* as shown. This allows for adjustment to get the proper distance from the center. The work is slipped on a pin driven in the center of *D* and clamped. One hole is finished, and *D* then given a half turn (the index pin locating D each time) and the other hole finished. Provision was made for oiling, and the fixture was properly balanced, so that it might be run at a high speed.

H. T. G.

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The Growth of the Machine Tool Industry.

It ought to be of some interest (to those who are engaged in the business, at least) to review the growth of the machine-tool industry since the AMERICAN MACHINIST was founded, twenty-five years ago. It may seem to smack of egotism to thus make the appearance of this journal a mark from which to count progress, but we are celebrating our twenty-fifth birthday, and if the beginning of the AMERICAN MACHINIST meant nothing more, it at least meant that in the judgment of men whose judgment has since been proven to be correct, the machinery-building interests of the country had at that time developed to such a point that a special representative was needed.

To get accurate information regarding the machine tool business as it existed twenty-five years ago has not been as easy as it might be imagined it would be. Many of the men who possessed accurate information of that period have gone to their final reward, and the men of to-day are more apt to have information about to-day and to-morrow than about the past. Nevertheless, by careful and persistent investigation we have gotten at the main facts and figures.

Twenty-five years ago there were only about twelve establishments making machine tools. They employed somewhat less than 2,000 men and had something under $2,000,000 invested in the business. To-day there are about 150 establishments building tools; they employ about 25,000 men and have invested in the business about $25,000,000.

These figures do not, of course, tell nearly all of the story, for each of the men now employed is able to and does turn out much more work per day than was possible at the time when this journal was founded. All the work of improvement that has been going on during the intervening quarter century has been directed toward the production of more and better work in machine shops, and where the prime cost of a machine has not been materially reduced, it is due either to a marvelously successful avoidance of the influence of modern ideas or to the fact that improvements made in the product have kept the cost up; the further fact being that very many tool builders are now selling tools at prices lower than they got in 1877, and yet the tools they now supply, if built by the methods and with the appliances of '77, would cost twice as much to build.

Twenty-five years ago few tools were built west of the Allegheny mountains, and Philadelphia was practically on the Western frontier of the tool-building territory; with, however, one important establishment in Hamilton, O., whereas now Ohio is a great machine-tool building State, Cincinnati and Cleveland both being important cities in this industry, and there are establishments scattered pretty much all over the rest of its territory; tools being also now built in Indiana, Illinois, Michigan and Wisconsin.

The growth of the business has not, however, been solely by the addition of new establishments, but has also been by the growth of establishments that were in business prior to '77. Taking ten of the most prominent concerns that were in the business twenty-five years ago, we find that since that time the number of men employed by them has increased from 1,560 to 9,845, or over 600 per cent.; that the floor area included in their establishments has increased from 200,720 square feet to 1,910,760 square feet, or about 550 per cent.; and that their capital invested has increased from $1,606,000 to $9,515,000, or nearly 600 per cent.

This is a splendid record and means not merely that the natural growth of the country has carried these establishments along with it, but also that the men who have managed the affairs of these establishments have been doing their full share to make the country develop industrially and in every other way.

Machine tools may be said to be at the foundation of the industrial structure. With them all other machinery is produced, and without them we should be reduced to the condition of hewers of wood and drawers of water. That nation which possesses the best machine tools will be almost certain to lead in industrial matters; for nothing can be much more certain than that the possession of the best machine tools carries with it the best knowledge of how to use them to the best advantage. Those who make good tools must first know a good deal about how tools should be used and what should be expected of them, and this means that they will also know how to produce the best of other machines and implements for carrying on the world's work.

The John Fritz Banquet.

The banquet in honor of Mr. Fritz, which was given at the Waldorf-Astoria the evening of October 31, was in every sense of the word a pronounced success. The guests, including ladies, numbered about 550.

The occasion was the inauguration of the John Fritz Gold Medal, which is to be awarded from time to time by a joint committee of the members of the civil, mechanical, mining and electrical engineering societies for meritorious engineering and industrial achievements.

The medal, which embodies perhaps the most unique testimonial to an individual in American history, is excellently shown in the accompanying half-tones, which are from a photograph of a bronze copy, 7 inches in diameter, of which one only has been made, and which was presented to Mr. Fritz at the banquet by Mr. John Thompson. The plaster mold from which the cast had been made was also present and, after explaining that but one casting had been made, Mr. Thompson,

to insure beyond peradventure that no more should be made, shattered the mold into fragments with a hammer, the effect being decidedly dramatic. With this bronze copy was also presented an album containing photographs of Mr. Fritz and of the medal, together with the autograph signatures of the subscribers to the medal fund.

Colonel H. G. Prout, who acted as toastmaster, in opening the proceedings made a capital speech which in form was a paraphrase on Lincoln's address at the battlefield of Gettysburg, the idea being that the founding of the medal could not add to the fame of Mr. Fritz and was rather an occasion in which the participants honored themselves and indicated their appreciation of Mr. Fritz's work.

Throughout all the speeches the dominating notes were the achievements of Mr. Fritz and the charm of his personality, and it may doubtless be said with truth that while Mr. Fritz's achievements furnish the justification of the act, the motive which has led to the commemoration of these achievements is the universal high regard in which the man is held. Such things are not done for men whose achievements are admired unless also their personal characters are such as to attach others to them.

A notable feature was the reading of telegraphic despatches of congratulation from various parts of the world. There were several such from Europe and one from Japan.

The dinner was held on the main floor of the great ballroom, which was filled with tables. The ladies occupied the first tier of boxes, which they filled.

The actual medals are to be of gold, 1,000 fine, the diameter being approximately 2½ inches. Upon the obverse side is a bas-relief portrait of Mr. Fritz, while upon the reverse is an allegorical figure personifying the messenger. In the right hand of the figure is a shield, upon which are to be engraved the name of the recipient and the date of the award. In the left hand are laurels and a palm branch, and in the background is the torch of knowledge, with a scroll for an inscription for the work for which the award was made.

THE JOHN FRITZ MEDAL.

Fraud in Correspondence Instruction.

We learn from the daily papers that the officers of the Correspondence Institute, of Scranton, Pa., have been arrested for fraudulent use of the mails. We do not imagine that any of our readers have been vicitimized by the concern, as the instruction which it professed to offer was in journalism, electricity, stenography, art illustrating and advertising writing; nor will our readers confound the "Institute" with the International Correspondence Schools, which happen to be located in the same town.

In connection with a plan being adopted by the superintendent of drawing of the Chicago high schools, drawings from back numbers of the AMERICAN MACHINIST will be utilized as practical examples by the fourth-year students in mechanical drawing. Beginning with the theory of the screw, bolts, cranks, cams, gears, worm gears, etc., will be taken up progressively, with applications of their use in the complete machine. Blueprints of the more appropriate drawings will be made, and the students will also be guided by the printed descriptions in the text accompanying the drawings.

Waiting.

She's at the door; from far away
I see her standing there; they say
That love grows cold ere long, but there
She waits for me; her face is fair
And smiles across her features play.

She's still as slim as on the day
That we were wed, and not a gray
Strand yet gleams in her wealth of hair—
She's at the door.

How bright the scene is, and how gay
The songs the birds sing as they sway
High on the limbs; how sweet the air,
How good the joys we have to share—
This is the day I draw my pay—
She's at the door.

S. E. Kiser in The Chicago Record-Herald.

Personal.

Wm. S. Rowell will go to Manchester, England, to be connected with the British Westinghouse Electric & Manufacturing Company.

W. M. Sawdon, of Manhattan, Kansas, where he has been assistant professor of mechanical engineering in the Kansas State Agricultural College, has accepted a position with the Armour Institute of Technology, of Chicago.

S. W. Robinson, professor emeritus of mechanical engineering in the Ohio State University, has given $5,000 to that institution to endow a scholarship in engineering. Under the laws of Ohio this money goes into the State treasury, where it becomes a part of the irreducible debt of the State, and commands 6 per cent. interest, payable semi-annually.

Commercial Review.

NEW YORK, November 3, 1902.

During the month of September the machinery industry gave evidence of a slight falling off in the volume of trade. This is the assurance given, not only by manufacturers and sales agents in this vicinity, but is also the conclusion that can be drawn from advices received by them from correspondents out of town.

Ordinarily a falling off in trade should be followed by dissatisfaction to a greater or less degree, according to one's conception of things, but in the present instance nothing but pleasure is expressed over the turn affairs took during the month.

One manufacturer, after informing the writer that his own business for September was lighter than that done by his house for some months recently, and after stating that several firms, to his personal knowledge, passed through a similar experience, said:

"The ease up in trade comes in the form of a genuine relief. During the past year everybody in the machinery line has been favored with a very profitable business, and it has been a case of work and worriment to take care of it. During the past month, however, things slackened a little, and we were enabled to catch up some on a variety of matters, which have not received their proper consideration, in consequence of the rush process through which we have been passing for months past. At the same time the outlook for trade is excellent, although there may be a probability of a little more hustling being necessary to obtain it than the situation has called for in many months."

Withal the volume of business done during the month was excellent. It was mostly made up of small orders, which made a large and profitable total. Within the next few weeks the probabilities are that many large contracts which have been hanging fire for several weeks past will be awarded.

The Crocker-Wheeler Company, of 39 Cortlandt street, this city, report an excellent business of late. Some recent orders received include complete motor equipments for the Quintard Iron Works, this city, and the Kleinert Rubber Company, College Point, L. I.; a complete lighting plant for the Garfield Worsted Mills, Garfield, N. J.; one 100-kilowatt generator for the Nevin-Church Press, Bloomfield, N. J.; one 75-kilowatt generator for the Hartford Carpet Works, Hartford, Conn., and a generator for lighting purposes from the Seymour Manufacturing Company, Seymour, Conn. The company also recently secured an order aggregating about $20,000 for motor-driven machines of various sizes from a large mining company in Mexico.

The C & C Electric Company, of Liberty and Washington streets, this city, have been especially busy filling small orders recently, the most important being a series of orders aggregating twenty-five motors for the Edison circuit in this city, ranging from 1 to 50 horse-power. They have also been given the order for the complete electrical equipment of the new hotel to be erected on Thirty-first street, near Fifth avenue, New York, and consisting, among other things, of two 125 horse-power engines and two 75-kilowatt generators. The contractors of the new Bellevue-Stratford Hotel have also given the company an order for six 20 horse-power motors to be used in drilling the shafts for the elevator excavation.

The engineering department of the Pittsburgh Gage & Supply Company, Pittsburgh, Pa., has been unusually rushed with work during the past few days. Recent orders are for one 150 horse-power boiler for the Lincoln Fire Brick Company, Bolivar, Pa.; one 150 horse-power boiler for the American Porcelain Company, New Brighton, Pa.; one 150 horse-power boiler for the Keystone Mining Company, Leadville, Colo., and one 35 horse-power automatic engine for the Clearfield Steam Laundry Company, Clearfield, Pa.

Reference was made in this column recently to the protest made by A. Milne & Co., of this city, against the action of the Customs authorities in Philadelphia in raising the price of 300 tons of German steel billets which recently arrived in that city for them to about 97 marks, despite the fact that the invoice stated they were purchased at 76½ marks, thus forcing Milne & Co. to pay duty at the rate of $8.96 per gross ton, instead of $6.72 per gross ton, as would have been the case if the invoice price had been taken as a basis for levying the duty.

It will also be recalled that General Appraiser Jewell gave a hearing to importers in the matter, at which they proved that German billets could be purchased for export at the price named in the consignment in question, although admitting that higher prices probably prevailed in all sales intended for domestic purposes in Germany.

General Appraiser Jewell handed down a decision during the week in the matter, to the effect that the price named by the Philadelphia authorities should be reduced about 10 marks, but that the duty should be $6.72 per gross ton, which is equivalent to three-tenths of a cent duty per pound.

So far as the duty is concerned, the decision is a triumph for the importers. In the matter of the price, however, it is a complete setback for them, and they propose to appeal from the decision, for, strange as it may seem, if they insist on truthfully stating the price which they pay for their billets on their invoices, the government will immediately turn around and fine them the 24 per cent. penal duty imposed for what it will call "undervaluation on invoice." Under Mr. Jewell's decision, if sustained, for example, Milne & Co. will have to pay that penalty, although they have shown that the billets were purchased at 76½ marks per 1,000 kilos in Germany, but the Customs authorities insist that they could not have been bought for less than 86 marks per 1,000 kilos.

It's a pretty state of affairs, and goes a good deal toward justifying the wag who compared the law to a certain species of the equine creation supposed to be incapable of brilliancy in any form. The importers propose to exhaust every remedy at their command before abiding by the decision of the General Appraiser.

Considerable comment is heard about the recent conference of Southern producers of pig iron relative to the price they propose to charge for their product during the last six months of 1903. One report, supposed to come from a reliable source, had it that they had agreed to charge $17 per ton for No. 2 Foundry at the furnace. It now transpires that whatever truth there was in this report simply related to the minimum figure the companies would name for the grade in question. As a matter of fact, however, none of the companies are receiving orders for less than $20 per ton. So far as this market is concerned, orders will undoubtedly be few and far between, for with the freight added this means that the price for delivery in New York would be $24.25 per ton. At this figure foreign irons will undoubtedly have the preference with consumers in this vicinity, since the best grades of them can be had for less than that, delivered in New York.

By some $20 per ton is not taken seriously, and by others it is looked upon as a a mistake. Apparently the companies do not propose to be caught next year as they were this, when they opened their books around $12 for No. 2 Foundry at the furnace, only to see the same go to $20, if not higher, and which was responsible for one company acknowledging that it lost several hundred thousand dollars in consequence.

The Garvin Machine Company, at Spring and Varick streets, this city, are doing an unusually good business at present. They recently received a large order for machine tools from the Searchmont Motor Company, of Philadelphia.

The National Machinery Company, of Tiffin, Ohio, state that the condition of business was never better in their history than it is at present, orders received during the last thirty days being exceptionally heavy. Judging from the amount of orders on hand and the inquiries received, the company does not anticipate any falling off of the present volume of trade for some time to come. The activity among the railroads has greatly increased the amount of business this fall, and the only difficulty encountered is to make early deliveries, which is greatly impeded by the condition of the raw-material market. The company have experienced an exceptional year in the wire-nail machine trade, but find business equally as good in all lines—bolt cutters, headers, bulldozers, spike machines, etc.

The Lunkenheimer Company, of Cincinnati, Ohio, manufacturers of valves, and who have a branch office at No. 26 Cortlandt street, this city, now have their new factory in Fairmount, near Cincinnati, in operation. The company's business has been increasing so rapidly that this new addition to their producing capacity will enable them to keep pace with their orders, more to their own and customers' satisfaction than recently.

Recent important contracts awarded the Air Compressor Department of the Chicago Pneumatic Tool Company include five cross-compound compressors of 600 feet capacity each for the Baltimore & Ohio Railroad; two compressors of 2,000 feet capacity each for the Pressed Steel Car Company; 2,000-foot compressor for the Kawasaki Dockyard, Japan; two 600-foot compressors for the New York, Ontario & Western Railroad, and one 700-foot compressor for the Signal Department of the New York Central & Hudson River Railroad.

The Toledo Machine & Tool Company, of Toledo, Ohio, report that their rapidly increasing business in punch presses, drop hammers, and other sheet-metal working machinery necessitates the enlargement of their plant. They have purchased an additional 125 horse-power engine and will add an entire new department to their plant, equipping the addition with lathes, planers, radials, shapers and other tools. They have just purchased an 84-inch iron planer with four heads. It is possible that steps will be taken to increase the capital stock to a quarter of a million dollars to provide additional capital for the handling of their increasing business.

CHICAGO MACHINERY MARKET.

The common report among the machine-tool representatives at Chicago is that trade is satisfactory, and by this somewhat indeterminate name is meant fairly good. Perhaps the most notable feature of the situation is that there is little business now in sight, and that there has been little trading in sight during the month now ending. But those sellers who have had faith in the future have not been disappointed. Dullness one day has been succeeded by good buying the next. The head of one local machine-tool house says he had thought the month was rather poor until the sales were footed up towards the close, when he found it fully up to a good average month. And all sellers unite in this statement also that business has been of a widely distributed but not especially notable character. It has been the purchases of one machine, or of two or three at a time that have made up the month's trading.

There have been, however, several orders sought by a number of machine-tool makers. The St. Paul road bought a fairly good lot of tools, the valuation of which is estimated by one manufacturer's representative at $20,000, for the shops at West Milwaukee, to displace a lot of old tools which had outgrown their usefulness. The appropriation for this purchase was made some time ago, but not until quite recently was the purchase made. The Goss Printing Press Company has bought about $3,000 worth of tools from the O. L. Packard Machinery Company. The Milwaukee Harvester Company bought from McDowell & Stocker and from other sellers a considerable number of new machine tools. The Morgan-Gardner Electric Company, Chicago, bought a few. The Dawson Machinery Company, among its other orders, sent several large machines out to Portland, Ore. But, as noted above, the mass of the month's trading consisted of the solitary, or detached, purchases.

Several buyers have been heard to say that the end of the year is approaching and that they may defer some of their purchases until early in 1903. That kind of talk is perhaps of little weight as an actual market factor, for the tools that are now bought are needed and are going directly into use. And this has been the character of the buying for some time. One representative, who has been long on the street, says he can notice an improvement in the class of buying. Machine-shop men, who not long ago usually looked around for second-hand tools, are now buying new ones, or differentiating a little more; buyers of poor second-hand machines are satisfied with nothing but the better class of second-hand tools, while former buyers of the latter say they want the latest and newest that is out.

Prices are everywhere reported to be firm. On some factory products there is an improvement in deliveries, but the larger machines are often slow in reaching the buyers.

Quotations.

NEW YORK, Monday, November 3.

New York prices for Northern and Southern irons for the first half of 1903 are as follows:

Northern:	
No. 1 X	$23 25 @ $24 75
No. 2 X	22 00 @ 22 75
No. 2 plain	21 00 @ 21 75
Southern:	
No. 1 Foundry	23 25 @ 23 50
No. 2 Foundry	22 25 @ 22 50
No. 3 Foundry	21 50 @ 22 00
No. 4 Foundry	20 50 @ 21 50

Br Iron—Base sizes—Refined brands, mill price on dock, 1.93c. upward in carload lots. Smaller quantities from store, 2.15 @ 2.20c.

Tool Steel—Base sizes—Good standard quality, 7c.; extra grades, 10c. and upward.

Machinery Steel—Base sizes—From store, 2.10 @ 2.25c.

Cold Rolled Steel Shafting—2.90c. from store for base sizes.

Copper—Lake Superior ingot, 11⅝ @ 11⅞c.; electrolytic and casting, 11½ @ 11¾c.

Pig Tin—In 5- and 10-ton lots, f. o. b. New York, 26⅝ @ 26⅞c.

Pig Lead—4.10 @ 4.12½c., in 50-ton lots.

Spelter—5⅜ @ 5½c.

Antimony—Cookson's, 9½c.; Hallett's and U. S., 7¼ @ 7¾c.

Lard Oil—Prime City, 89 @ 91c., according to brand and quantity ranging from one barrel up to large lots.

New Corporations.

Advance Pump & Compressor Company, of Battle Creek, Mich.; capital, $150,000.

The Contoocook Needle Company, of Contoocook, N. H.; capital stock, $12,000; object, manufacturing needles and supplies.

Johnson Iron Co., Gouverneur, St. Lawrence County, N. Y.; capital, $30,000. Directors: J. B. Johnson, H. B. Johnson and H. D. Hill, Gouverneur.

It is reported from Newcastle, Pa., that the Shenango Valley Steel Mill has closed down on account of inability to secure coal for the boilers. The plant employs about 1,000 men.

It is reported from Trenton, N. J., that the United States Steel Corporation is to spend $1,000,000 in enlarging the local plant of the American Bridge Company. The output will be doubled.

Cooper Underwear Co. of Kenosha, Wis.; capital stock, $100,000. Incorporators: Willis W. Cooper, Charles F. Cooper and Henry Cooper. It is announced that a factory will be built in the early spring.

Specialty Manufacturing Co.; object, manufacturing metallic packing, core-box planes, etc.; capital, $50,000. Incorporators: George W. Gaines, of Newark, N. J.; W. B. Moore, of Jersey City, and J. Edwin Crater.

Maxwell M. Mayer Electrical Co., incorporated in New Jersey, for manufacturing dynamos and other electrical machinery and to supply electric power; capital, $10,000. Directors: Christian E. Hartshorne, Marshall L. Osgood and Paul E. Hirsch.

The Seri-Culture & Manufacturing Company, capitalized at $250,000, has applied for a charter. It proposes to raise and manufacture silk in Georgia. The incorporators are Louis B. Magid, of Habersham County, and W. R. Sweet, of Rabun County. The main office will be located in Atlanta.

It is rumored that negotiations are about completed between the Singer Manufacturing Company, of Elizabethport, N. J., and the Musconetcong Iron Company, of Stanhope, N. J., for the transfer of the mining plant to the sewing machine manufacturers. It is said to be the intention of the Singer company to mine ore at Mine Hill, make its own iron and build a rolling mill at Stanhope.

Chapman Fuel Economizing System, of Albany, N. Y.; capital, $35,000; object, manufacturing a certain invention of John S. Chapman, to be used for economizing in the use of fuel, arresting smoke and increasing steam boiler capacity. Directors: John S. Chapman, Isaac La Grange, James W. Bentley and B. A. Chapman, of Albany; John Pressley, M. Pressley and M. Weighill, of Rochester.

Articles of incorporation for the American Sault Ste. Marie Paper Company, with a capital stock of $4,000,000, have been filed at Augusta, Me., by J. P. Hummell, Cassius M. Paine and John H. Gault, Milwaukee, Wis. The company is organized for the purpose of building and operating a pulp and paper mill on the Chandler and Dunbar water power, at

Sault Ste. Marie, Mich. Theodore F. Rice, of Chicago, who for many years was vice-president and general manager of Bradner Smith & Co., Inc., of that city, assisted in the formation of the company.

New Catalogs.

Jos. T. Ryerson & Son, Chicago, Ill. "Continental" boilers. 6¼x3¼, pp. 20, paper.

F. E. Hook, Hudson, Mich. Pneumatic painting machines. 3½x6, pp. 16, paper.

Pittsburg Blue Print Company, Pittsburg, Pa. Blueprinting machines. 6x9, pp. 15, paper.

Green Engineering Company, Chicago, Ill. Green traveling link grate. Catalog C, 7x10, pp. 35, paper.

National Supply Company, Chicago, Ill. The "Billow" system of fuel oil appliances. 6x9, pp. 39, paper.

Eastern Machinery Company, New Haven, Conn. Friction clutches, clutch pulleys and cut-off couplings. 6x9, pp. 56, paper.

Woodward Governor Company, Rockford, Ill. Circular illustrating and describing the Woodward friction water wheel governor.

Wisconsin Graphite Company, Pittsburg, Pa. Two novel and attractively designed little booklets treating on graphite paints and flake graphites.

Massachusetts Fan Company, Waltham, Mass. "Davidson" propeller fans. Sectional Catalog No. 50. 7x9½, pp. 32, decorated paper cover.

Buffalo (N. Y.) Dental Manufacturing Company. Brazing stands, blow pipes, tool forges, foot blowers, gas burners. Catalog G, 6x9, pp. 15, paper.

Buffalo Forge Company, Buffalo, N. Y. "Mechanical Induced Draft" and "Buffalo Forge Company Engine," two attractive booklets, 6½x3½.

Buffalo Forge Company, Buffalo, N. Y. Buffalo down-draft stationary and heating forges, for industrial works. 3½x6½, pp. 52, embossed paper cover.

McLeod Company, 95 Liberty street, New York. Announcement of completion of new flange fitting and pipe shop at New Brighton, Staten Island, N. Y.

Jeansville (Pa.) Iron Works Company. Advance sheet No. 15 descriptive of the "Jeansville Pump." 8x11, pp. 20, paper; and No. 16 covering condensers.

Felt & Tarrant Manufacturing Company, 52-56 Illinois street, Chicago, Mich. "Mechanical Arithmetic," the "Comptometer." 4½x6, pp. 28, paper.

Etna Manufacturing Company, 40 John street, New York. Twist drills, taps and dies, reamers, milling cutters, hack saws and machinists' small tools. 6x9, pp. 31, paper.

Spon & Chamberlain, 123 Liberty street, New York. Catalog of books covering civil, mechanical, sanitary, marine, electrical and steam engineering. 6¾x4¾, pp. 199, paper.

Harrison Safety Boiler Works, Philadelphia, Pa. "Economy for Collieries," descriptive of the Cochran feed water heater and purifier and the Sorge-Cochrane system. 3½x6, pp. 12, paper.

The V. D. Anderson Company, Cleveland, Ohio. The Anderson Dryers, 6x9, pp. 66, paper. Appended to this catalog are a number of pages devoted to useful information on general mechanical matters.

Cincinnati (Ohio) Milling Machine Company. Milling machines and cutter grinders. Illustrating and describing in detail the construction of the Cincinnati milling machines. Printed on coated paper, half-tone illustrations. 6x9, pp. 89, paper.

The Lunkenheimer Company, Cincinnati, Ohio. General catalog of valves, injectors, whistles, lubricators, oil and grease cups and steam specialties; profusely illustrated, appended by tables and data containing useful information. 5x7, pp. 208, paper.

Christensen Engineering Company, Milwaukee, Wis. "Straight Air-Brake Equipments for Electric Cars"; catalog No. 53, 6x9¼, pp. 57, paper. "Ceco" Electrical Machinery; catalog No. 55, 6x9, pp. 53, paper. "Christensen Air Brakes, Where Made and Where Used"; publication No. 54, gotten up for distribution at the recent convention at Detroit of the American Street Railway Association. 6x9, pp. 49, paper.

Manufacturers.

The Lorain (O.) Foundry Company will build extensions.

The W. D. Williams foundry, Fredericksburg, Va., will be rebuilt.

Flouring mills of Frank Windiate, Paulding, O., have been burned.

The Kansas City *Star* will build a mill in which to make its own paper.

The Whitlock Coil Pipe Company, Elmwood, Conn., is erecting an addition.

The Baltimore (Md.) Sash & Door Company will build a new factory.

A factory of the Diamond Match Company is to be located at Durham, Cal.

The D. M. Tuttle Company, Canastota, N. Y., is adding to its boat factory.

Vaughan & Co., of Detroit, Mich., intend to erect a canning factory at Pontiac.

The Northwest Paper Company, Cloquet, Minn., will build a mill at Brainerd.

Harkins & Maheim, Berlin, N. H., brass founders, are enlarging their plant.

Seeboth Bros. will have plans prepared for a cotton felting mill in Milwaukee, Wis.

The Illinois Sewing Machine Company, Rockford, Ill., may build two additions.

The Girard Foundry & Machine Company, Girard, O., is building an addition to its plant.

The Acme Railway Signal Company has decided to move from Galesburg to East Peoria, Ill.

The Concord Manufacturing Company, Penacook, N. H., woolen goods, will build an addition.

The Vincent Valve Company, Sandusky, O., is erecting an iron foundry as well as a brass foundry.

Fire has destroyed the six-story building occupied by the Minneapolis (Minn.) Paper Company.

The Grand Rapids (Mich.) Fixtures Company, manufacturer of show cases, etc., is enlarging its plant.

The National Cereal Milling Company, Chicago, Ill., proposes to build a large corn and oats mill at Peoria.

The American Circular Loom Company, Chelsea, Mass., proposes to build a two-story factory, 40x120 feet.

A. Erdrich & Son, brewers, Frankford, Philadelphia, are about to put up a mill, malt storage and stock-house.

The Ohio Stove Pipe & Manufacturing Company will erect a new factory near its plant at New Philadelphia, O.

The Deshler (Neb.) Broom Company will erect a factory. The main building is to be three stories, 300x40 feet.

Another addition is to be built to the large plant of the New England Enameling Company at Middletown, Conn.

The Link-Belt Machinery Company, Chicago, Ill., will erect a warehouse, 125x168 feet, to cost about $25,000.

R. S. Fram, of Vandalia Ill., will build a paper mill at St. Elmo, where a company has been formed for the purpose.

Baring, Me., is to have a pulp mill. The promoters are H. E. Dowst and Irving R. Todd, well-known lumbermen.

A factory, to cost about $250,000 when equipped, will be erected at St. Louis, Mo., by the Universal Machine Company.

The Lancaster Castings Company, of Philadelphia, proposes to build a factory at Lancaster, Pa., to employ 200 hands.

A paper box factory, 100x200 feet, seven stories, is about to be built at 6 East Superior street, Chicago, for Henry Schultz.

There are plans to enlarge the soap plant of S. W. Bell & Co., Toledo, O., and for that purpose to organize a new company.

Michael J. Bernhard, Buffalo, N. Y., manufacturer of saloon fittings, billiard tables, etc., has filed plans for a factory building.

The National Wood Works, which manufacture sashes, doors, blinds and moldings, have decided to locate in Sioux City, Ia.

A sawmill will be built at East Jacksonville, Fla., by the Standard Cypress Company, incorporated under the laws of Michigan.

The Fairmont Powder Works, eighteen miles from Fairmont, W. Va., have been damaged by an explosion, destroying machinery.

The Queen City Varnish Company, Cincinnati, O., has purchased a tract of land in Idlewild, Norwood, for a new factory building.

Plans have been filed at Buffalo, N. Y., for a factory building, 80x43 feet, three stories, for the Wright Taper Roller Bearing Company.

W. A. Proctor proposes to utilize property at Fourth and Plum streets, Cincinnati, for a light manufacturing building to be equipped with power.

Crowded quarters in the plant of the American Playing Card Company, Kalamazoo, Mich., will probably cause another building to be put up.

Kane & Roach, Syracuse, N. Y., are to erect a 60x80-foot building which, we understand, will be used in the manufacture of rolling-mill machinery.

A permit has been applied for, to build a two-story brick factory at Hamilton and Bruen streets, Newark, N. J., for the Barnett Foundry Company.

The Brown-Coughran Company will build a factory for refrigerating machinery, but it is not quite clear whether the location is Lorain, O., or Cleveland.

The Stanley Instrument Company, manufacturer of electrical appliances, Great Barrington, Mass., now has plans under consideration for a still further addition.

The Clarinda (Ia.) Mining & Manufacturing Company has been organized. It will mine coal and manufacture pressed and paving brick, etc. T. E. Powers is one of the directors.

An addition to the plant of the D. E. Whiton Machine Company, manufacturer of chucks, etc., New London, Conn., has reached the fourth story. The foundation is in for a foundry.

The Nazel Engineering Works, of Philadelphia, Pa., have moved into larger quarters at Hamilton and Ridge avenues. Their new keyseater and centering machines will shortly be placed on the market.

The Humphrey Manufacturing & Plating Company, Kalamazoo, Mich., manufacturer of water heaters, etc., will erect a new structure to be used, among other purposes, as an engine and boiler building.

The Chicago Railway Equipment Company, of Chicago, has bought out the Monarch Brake Beam Company, and intends to erect a plant in Detroit, to employ between 75 and 100 workmen at the start.

John Clove and W. T. Rigby have submitted a proposition to a committee of the Pendleton (Ore.) Commercial Association regarding the erection of manufacturing machine shops to cost $30,000.

Thirty acres of land at Chicago have been acquired by Pettibone, Mulliken & Co., Inc., of that city, for a plant for the manufacture of railway supplies, in which about 500 men will be employed at the start.

The National-Acme Manufacturing Company, maker of screw machines, screws, etc., Cleveland, O., announces the opening of its New England office, M. M. Brunner, manager, 45 Oliver street, Boston, Mass.

The Albion (Ill.) Vitrified Brick Company is being organized to build a plant. Those concerned include J. H. Lacey, Thomas Hodgson, Samuel Churchill, A. H. Bowman, Walter Colyer, B. F. Michels and W. H. Brosman.

Sargent, Conant & Co., of Boston, Mass., have purchased the construction business of the Hawks Electric Company, of that city, together with the good will, stock, tools, etc., pertaining thereto, and will complete its outstanding contracts.

Plans have been prepared for a two-story factory building at Madison, Wis., for the American Manufacturing Company, of Racine, maker of threshing machine attachments. The building is 310x100 feet inclusive of foundry, which is 60x100 feet.

United States Senator A. G. Foster, of Washington; L. W. Blinn, of Los Angeles, and James Tyson, of San Francisco, are among the incorporators of the Southwestern Lumber Company, which, it is rumored, will build a planing mill in San Pedro, Cal.

The Broderick-Quinlan Manufacturing Company, of Montpelier, Ind., thinks of moving its plant to a larger city. The company manufactures boilers and machinery largely used in the oil field, and when enlarged as planned will give employment to 300 or 400 men.

James J. Hill, president of the Great Northern Railway and the Nortnern Securities Company, has begun the creation of a great steel and iron industry in the West. He arrived in Great Falls, Mont., October 30 to arrange, it is reported, for the transformation of the old silver smelter of the American Smelting & Refining Company into an iron and steel mill.

At a fire in a power building in Detroit, Mich., the following firms are said to have suffered: Michigan Stamping Company; Horatio Barr, steel cotter manufacturer; Chicago Hosiery Company, the Reliance Gas Engine Company, the Eagle Box Company, the Physicians' Chemical Company, Dodge Bros.' machine shop and the Phoenix Wire Works. The total damage, including that to the building is, however, estimated at only $30,000.

The Ingersoll-Sergeant Drill Company, of which ex-Mayor Grace, of New York, is president, and whose works have been located at Easton, Pa., for eight years past, are erecting an entirely new plant at Phillipsburg, Pa., only three or four miles from their present location. The company employs 1,500 men, and floods on the Lehigh River and the impossibility of securing sufficient land in their present location for the needs of their rapidly growing business have compelled the change.

It is reported from Sharon, Penn., that the malleable iron combination has been completed. The National Malleable Castings Company, owning plants at Sharon, Toledo, Cleveland, Indianapolis and Chicago, refused to enter, as did two other concerns. The capital of the new concern is placed at $20,000,000. The concerns involved are Pratt & Letchworth Company, Buffalo, N. Y.; Michigan Malleable Iron Company, Detroit, Mich.; Whiteley Malleable Castings Company, Muncie, Ind.; Chicago Malleable Castings Company, West Pullman, Ill., and the Moline Malleable Iron Company, St. Charles, Ill. It is said that Judge Gary and Max Pam, of New York, are the promoters.

Miscellaneous Wants.

Advertisements will be inserted under this head at 25 cents a line, each insertion. Copy should be sent to reach us not later than Saturday morning for the ensuing week's issue. Answers addressed to our care will be forwarded.

Gear Wheels, gear cutting. Grant; see p. 220.

Punches & dies. Wal.M.Wks.,Waltham,Mass.

Caliper cat. free. E. G. Smith, Columbia, Pa.

Stamping Dies. Emmons Collins, Chicago.

Mfg. plants, space, powers. A. Ela, Boston.

Will buy or pay royalty for good patented machine or tool. Box 282, AMER. MACH.

Wanted—Improvements in grinding machinery. Address Box 1435, Providence, R. I.

Agents wanted in every shop to handle my test indicator. H. A. Lowe, Waltham, Mass.

Light and fine mach'y to order; models and elec. work specialty. E. O. Chase, Newark, N. J.

Inventors and light mach'y.; jewelers' tools a specialty. Industrial Machine Co., Newark, N. J.

Corliss engine diagram, 13x19 in., with full descriptive matter, by mail for 25c. Spon & Chamberlain, 123 Liberty, New York.

An experienced engineer will perfect, simplify or improve upon articles of manufacture. Address Box 129, AMERICAN MACHINIST.

Wanted—Nos. 2 to 15 incl., Nos. 25, 29, 30, 34 to 37 incl., all of Vol. 4 and complete Vols. 1 and 2. Address Box 186, AMER. MACH.

Wanted—A first-class machinery molder for high-grade work in small foundry; $500 to $1,000 stock required. Address D., care A. M.

Oil Engines.—Book by Goldingham; valuable for designers, builders, users of oil or gas engines; $2. Spon & Chamberlain, 123 Liberty, New York.

A well-known practical M. E., having office in Pittsburg, would like to hear from parties desiring active local representation. Box 152, AMERICAN MACHINIST.

Wanted—To lease machine shop, 7,500 to 10,000 square feet, equipped for medium work; New Jersey or eastern Pa. preferred. Box 183, AMERICAN MACHINIST.

For Sale—Iron foundry located within 40 miles of Pittsburgh, Pa.; now running at full capacity and large trade to draw on. Box 104, AMERICAN MACHINIST.

For Sale—Working drawings stationary type steam engine, 1 to 40 H.-P., eight sizes; first class in every particular; rare opportunity. Box 134, AMERICAN MACHINIST.

We manufacture on contract patented hardware specialties, tools, dies, metal stampings, special machinery, etc. Edmonds-Metzel Mfg. Co., 778 to 784 W. Lake st., Chicago, Ill.

Grinding beats filing; try us, on either hardened or soft work; capacity 7 in. diameter, 48 in. long and under. The Garvin Machine Co., Spring and Varick sts., New York.

For Sale—One Blaisdell lathe, 13 in. swing, 8 ft. bed, compound rest, taper attachment, power cross feed; never used; cost $258; price $248. Address B. F. Grout, West Derby, Vt.

Wanted—Light machine work and special machinery to build to order, special tools, dies and punches; a well-equipped water-power plant and first-class workmen. The Bantam Mfg. Co., Bantam, Conn.

Wanted—Machinist, with from $1,000 to $2,000, to take an interest in and the superintendency of a concern manufacturing laundry machinery in Chicago. Address C. T. Cummins, 210 Larrabee st., Chicago, Ill.

Wanted—A large contract to build medium or light automatic machinery; we have the plant, the experience, the capital; cam cutting a specialty; we make the best adjustable reamers. Ott. Mergenthaler Company, Baltimore, Md.

For Sale—New foundry, completely equipped, 60x380, on Erie Canal and Delaware & Hudson Railroad, near Albany; also complete machine shops and forging plant at Troy. Address Pneumatic Signal Company, Broad Exchange, New York.

Purchaser for small manufacturing plant in Madison, Wis.; lot, 100x180 feet; machine shop, 32x68, two story, with line shaft and gasoline power; foundry, 40x54, new modern equipment; good location; for sale cheap. Hart-Parr Co., Charles City, Iowa.

Wanted—To introduce practical American machinery in England and Europe; 8 years' continental business experience; 4 years in France; can speak the language; wide business relations; first-class references. Address Box 180, AMERICAN MACHINIST.

Wants.

Situation and Help Advertisements only inserted under this head. Rate 25 cents a line for each insertion. About six words make a line. No advertisements under two lines accepted, and no advertisements abbreviated. The cash and copy should be sent to reach us not later than Saturday morning for the ensuing week's issue. Answers addressed to our care will be forwarded. Applicants may specify names to which their replies are not to be forwarded; but replies will not be returned. If not forwarded they will be destroyed without notice. Original letters of recommendation or other papers of value should not be enclosed to unknown correspondents.

Situations Wanted.

Machine designer, etc., wants position. Address Box 63, AMERICAN MACHINIST.

First-class mechanical draftsman wants position. N. O., care AMER. MACHINIST.

As foreman, by A1, progressive patternmaker. K. G., care AMERICAN MACHINIST.

Mechanical draftsman, graduate, wants position. Box 178, AMERICAN MACHINIST.

Machinist wants situation on hexagon turret lathe. Box 181, AMERICAN MACHINIST.

Experienced mechanical draftsman wishes position near New York city. Box 185, A. M.

First-class, all-round machinist and toolmaker on chair and wood-working machinery wishes a change. Box 179, AMER. MACH.

Superintendent desires change; technical graduate; 13 years' experience in shop and drafting room. Box 184, AMER. MACHINIST.

Position wanted as general foreman or assistant superintendent; 20 years' experience on varied work; references. Box 147, AM. M.

By first-class hardener, 24 years old; expert on punch and drop-hammer dies, also fine case-hardening; references, etc. Box 182, AMERICAN MACHINIST.

Wanted—Position as foreman of pattern shop, by middle-aged man of wide experience; would invest some money with good concern. Box 177, AMERICAN MACHINIST.

A first-class toolmaker, experienced in manufacturing fine duplicate work, good business and executive ability, solicits correspondence. Box 171, AMERICAN MACHINIST.

A mechanical draftsman and practical machinist, with good knowledge of the foundry and patternmaking, desires responsible position; age 30. Box 188, AMER. MACH.

Employment for about five months wanted by experienced technical man of 32, now draftsman with steel company; work that is not all drafting preferred. Box 168, AM. M.

Mechanical engineer and chief draftsman, 30 years old, Swedish technical graduate, desires change; 9 years' experience on air compressors, pumps and gas engines. Box 159, AMERICAN MACHINIST.

Mechanical engineer; experienced in equipping and managing shops; specialty, designing tools for rapid manufacture of repetition work; can develop small automatic casting process. Address Box 157, AMER. MACH.

Expert on automatic machinery, light and heavy; first-class designer; inventive ability; 10 years' best experience; graduate; fitted for head draftsman, superintendent or to develop inventions; terms moderate. Box 187, A. M.

Patternmaker, 33 years, desires foremanship or steady position with chance of advancement; 2 years as successful foreman; experienced in machine, tool, architectural and jobbing work; A1 references; investigate. Box 189, AMERICAN MACHINIST.

Well paying position of highest mechanical and business responsibilities desired by young man, successful in both, and who has no superior as engineer and practical expert in designing and developing machinery; 10 years present place. Box 173, AMER. MACHINIST.

Young mechanical engineer; technical education; experience in shops, drawing room and on the road; at present employed as editor of engineering magazine, but wishes change; is a hustler and can get along with people; references from past and present employers. Anyone desiring the services of such a man address Box 13, AMER. MACHINIST.

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Cushman Chuck Co., Hartford, Ct.
Goodell-Pratt Co., Greenfield, Mass.
The E. Horton & Sons Co., Windsor Locks, Conn.
Morse Twist Drill & Mch. Co., New Bedford, Mass.
Pratt Chuck Co., Frankfort, N. Y.
Standard Tool Co., Cleveland, O.
Trump Bros. Mach. Co., Wilmington, Del.
Whitney Mfg. Co., Hartford, Ct.
Whiton Mach. Co., D. E., New London, Conn.

Chucks, Scroll
Leavitt Mach. Co., Orange, Mass.
Whiton Mach. Co., D. E., New London, Conn.

Chucks, Lathe
Cushman Chuck Co., Hartford, Ct.
Hoggson & Pettis Mfg. Co., New Haven, Conn.
The E. Horton & Son Co., Windsor Locks, Conn.
Montgomery & Co., New York.
Pratt & Whitney Co., Hartford, Conn.
Skinner Chuck Co., New Britain, Conn.
Westcott Chuck Co., Oneida, N. Y.
Whiton Mach. Co., D. E., New London, Conn.

Chucks, Split
Faneuil Watch Tool Co., Boston, Mass.
Hardinge Bros., Chicago, Ill.

Clutches, Friction
Caldwell, Son & Co., H. W., Chicago, Ill.
Coil Clutch Mfg. Co., New York.
Eastern Mchry. Co., New Haven, Conn.
Faneuil Watch Tool Co., Boston, Mass.
Jacobson Mach. Mfg. Co., Warren, Pa.
New Haven Mfg. Co., New Haven, Conn.
Oesterlein Mach. Co., Cincin., O.
Patterson, Gottfried & Hunter, Ltd., New York.
Pratt & Whitney Co., Hartford, Conn.

Clutches, Magnetic
Electric Controller & Supply Co., Cleveland, O.

Compound, Tempering
Mosso, C. A., Dryden, N. Y.

Compressors, Air
Blanchard Mach. Co., Boston, Mass.
Chicago Pneumatic Tool Co., Chicago, Ill.
Christensen Engineering Co., Milwaukee, Wis.
Clayton Air Compressor Works, New York.
Curtis & Co. Mfg. Co., St. Louis, Mo.
Gray-Blaisdell Co., Bradford, Pa.
Herron & Bury Mfg. Co., Erie, Pa.
Ingersoll-Sergeant Drill Co., New York.
Jacobson Mach. Mfg. Co., Warren, Pa.
Rand Drill Co., New York.

Consulting Engineer
Thompson, Hugh L., Waterbury, Conn.

Controllers
Electric Controller & Supply Co., Cleveland, O.

Coping Machines
Long & Allstatter Co., Hamilton, Ohio.

Correspondence Schools
See Schools, Correspondence.

Cost Keeping System
Rogers, W. S., Keene, N. H.

Countershafts
Builders' Iron Fdry., Provi., R. I.
Oesterlein Mach. Co., Cincin., O.
Pratt & Whitney Co., Hartford, Conn.
Reeves Pulley Co., Columbus, Ind.
Wilmarth & Morman Co., Grand Rapids, Mich.

Counting and Printing Wheels
Franklin Mfg. Co., Syracuse, N. Y.

Couplings, Shaft
Caldwell & Son Co., H. W., Chicago, Ill.
Cresson Co., Geo. V., Philadel., Pa.
Davis Mach. Co., W. P., Rochester, N. Y.
Patterson, Gottfried & Hunter, Ltd., New York.
Stuart, R. J., New Hamburg, N. Y.
Vandergrift Coupling Co., Evansville, Ind.

Cranes
Brown Hoisting Mach. Co., N. Y. City.
Case Mfg. Co., Columbus, O.
Chicago Pneumatic Tool Co., Chicago, Ill.
Cleveland Crane & Car Co., Cleveland, O.
Curtis & Co. Mfg. Co., St. Louis, Mo.
Franklin Portable Crane & Hoist Co., Franklin, Pa.

Cranes—*Continued*
Moyer & Co., J. W., Philadel., Pa.
Maris Bros., Philadelphia, Pa.
Niles-Bement-Pond Co., New York.
Northern Engineering Works, Detroit, Mich.
Pawling & Harnischfeger, Milwaukee, Wis.
Sellers & Co., Wm., Philadel., Pa.
Whiting Foundry Equipment Co., Harvey, Ill.

Crank Pin Turning Machines
Underwood & Co., H. B., Philadelphia, Pa.

Crucibles
Dixon Crucible Co., Jos., Jersey City, N. J.

Cupolas, and Ladles, Foundry
Byram & Co., Detroit, Mich.
Northern Engr. Works, Detroit, Mich.
Obermayer Co., S., Cincinnati, O.
Paxson Co., J. W., Philadel., Pa.
Whiting Foundry Equip. Co., Harvey, Ill.

Cutters, Milling
Becker-Brainard Milling Mch. Co., Hyde Park, Mass.
Brown & Sharpe Mfg. Co., Providence, R. I.
Cleveland Twist Drill Co., Cleveland, O.
Gay & Ward, Athol, Mass.
Ingersoll Milling Mach. Co., Rockford, Ill.
Montgomery & Co., New York.
Morse Twist Drill & Mach. Co., New Bedford, Mass.
Rogers, John M., Boat, Gage & Drill Works, Gloucester City, N. J.
Standard Tool Co., Cleveland, O.

Cutting-off Machines
Bement, Miles & Co., New York.
Brown & Sharpe Mfg. Co., Providence, R. I.
Davenport-McCullough Mfg. Co., Blissfield, Mich.
Davis Mach. Co., W. P., Rochester, N. Y.
Dwight Slate Mach. Co., Hartford, Conn.
Franklin Mach. Wks., Phila., Pa.
Hurlbut-Rogers Mach. Co., South Sudbury, Mass.
Newton Mach. Tool Wks., Philadelphia, Pa.
Nutter, Barnes & Co., Boston, Mass.
Niles Tool Works Co., New York.
Pond Mach. Tool Co., New York.
Western Mfg. Co., Springfield, O.

Cutting off Tools
Armstrong Bros. Tool Co., Chicago, Ill.
Pratt & Whitney Co., Hartford, Conn.

Diamond Tools
Dickinson, Thos. L., New York.

Dies, Sheet Metal
Bliss Co., E. W., Brooklyn, N. Y.
Perkins Mach. Co., So. Boston, Mass.
Wold & Co., Torris, Chicago, Ill.

Dies, Threading, Opening
Errington, F. A., New York.
Geometric Drill Co., New Haven, Conn.
Jones & Lamson Mch. Co., Springfield, Vt.
Modern Tool Co., Erie, Pa.
Pratt & Whitney Co., Hartford, Conn.

Dowel Pins
Diamond Clamp & Flask Works. Richmond, Ind.
Winkley Co., Hartford, Conn.

Drafting Machine
Universal Drafting Machine Co., Cleveland, O.

Drawing Boards and Tables
Alexander Mfg. Co., J. G., Grand Rapids, Mich.
Rich, J. & G., Philadelphia, Pa.

Drawing Instruments
Alteneder & Son, Theo., Philadelphia, Pa.
Keuffel & Esser Co., New York.

Drilling Machines, Bench
Barnes Co., W. F. & John, Rockford, Ill.
Pratt & Whitney Co., Hartford, Conn.

Drilling Machines, Boiler
Aurora Tool Works, Aurora, Ind.
Baush Mch. Tool Co., Springfield, Mass.
Bickford Drill & Tool Co., Cincinnati, O.
Bement, Miles & Co., New York.
Dallett & Co., Thos. H., Phila., Pa.
Niles Tool Works Co., New York.
Pond Mach. Tool Co., New York.
Prentice Bros. Co., Worcester, Mass.

Drilling Machines, Multiple Spindle
Baker Bros., Toledo, O.
Barnes Co., B. F., Rockford, Ill.
Barnes Co., W. F. & John, Rockford, Ill.
Baush Mch. Tool Co., Springfield, Mass.
Bement, Miles & Co., New York.
Bickford Drill & Tool Co., Cincinnati, Ohio.
Dallett & Co., Thos. H., Phila., Pa.
Fenn-Sadler Mach. Co., Hartford, Conn.
Garvin Mach. Co., New York.
Harrington, Son & Co., Edwin, Philadelphia, Pa.
McCabe, J. J., New York.
Marshall & Huschart Mchry. Co., Chicago, Ill.
Marshall & Huschart Mchry. Co., Cleveland, O.
Newton Machine Tool Works, Philadelphia, Pa.
Niles Tool Works Co., New York.
Prentice Bros. Co., Worcester, Mass.
Prentiss Tool & Supply Co., New York.

Drilling Machines, Pneumatic
Chicago Pneumatic Tool Co., Chicago, Ill.
Cleveland Pneu. Tool Co., Cleveland, Ohio.
Columbus Pneumatic Tool Co., Columbus, O.
Phila. Pneumatic Tool Co., Philadelphia, Pa.
Prentice Bros. Co., Worcester, Mass.
Q & C Co., Chicago, Ill.
Standard Ry. Equip. Co., St. Louis, Mo.

Drilling Machines, Portable
Dallett & Co., Thos. H., Phila., Pa.

Drilling Machines, Radial
American Tool Wks. Co., Cin., O.
Baush Mch. Tool Co., Springfield, Mass.
Bement, Miles & Co., New York.
Bickford Drill & Tool Co., Cincinnati, Ohio.
Cleveland Punch & Shear Works Co., Cleveland, O.
Dreses Mach. Tool Co., Cincin., O.
Fosdick Mach. Tool Co., Cincin., O.
Gang Co., Wm. E., Cincinnati, O.
Harrington, Son & Co., Edwin, Philadelphia, Pa.
Hill, Clarke & Co., Boston, Mass.
McCabe, J. J., New York.
Marshall & Huschart Mchry. Co., Chicago, Ill.
Marshall & Huschart Mchry. Co., Cleveland, O.
Mueller Mach. Tool Co., Cincin., O.
Niles Tool Works Co., New York.
Pond Mach. Tool Co., New York.
Prentice Bros. Co., Worcester, Mass.
Prentiss Tool & Supply Co., New York.
Reade Mchry Co., Cleveland, O.

Drilling Machines, Turret
Niles Tool Works Co., New York.
Quint, A. D., Hartford, Conn.
Vanderbeek Tool Wks., Hartford, Conn.

Drilling Machines, Upright
American Tool Wks. Co., Cin., O.
Aurora Tool Works, Aurora, Ind.
Baker Bros., Toledo, O.
Barnes Co., B. F., Rockford, Ill.
Barnes Co., W. F. & John, Rockford, Ill.
Bement, Miles & Co., New York.
Blaisdell & Co., P., Worcester, Mass.
Cincinnati Mach. Tool Co., Cin., O.
Davis Mach. Co., W. P., Rochester, N. Y.
Dwight Slate Mach. Co., Hartford, Conn.
Fosdick Mach. Tool Co., Cincinnati, O.
Gould & Eberhardt, Newark, N. J.
Harrington & Son Co., Edwin, Philadelphia, Pa.
Hill, Clarke & Co., Boston, Mass.
Hoefer Mfg. Co., Freeport, Ill.
Knecht Bros. Co., Cincinnati, O.

Drilling Machines, Upright—*Cont'd*
Le Blond Mach. Tool Co., R. K., Cincinnati, O.
McCabe, J. J., New York.
Marshall & Huschart Mchry. Co., Chicago, Ill.
Marshall & Huschart Mchry. Co., Cleveland, O.
Niles Tool Works Co., New York.
New Haven Mfg. Co., New Haven, Conn.
Pratt & Whitney Co., Hartford, Conn.
Prentice Bros. Co., Worcester, Mass.
Prentiss Tool & Supply Co., New York.
Reed Co., Francis, Worcester, Mass.
Sibley & Ware, South Bend, Ind.
Washburn Shops, Worcester, Mass.

Drills, Center
Pratt & Whitney Co., Hartford, Conn.
Slocomb & Co., J. T., Providence, R. I.

Drills, Rail
Bement, Miles & Co., New York.
Niles Tool Works Co., New York.

Drills, Ratchet
Parker Co., Chas. Meriden, Ct.
Pratt & Whitney Co., Hartford, Conn.

Dynamos
Akron Elec. Mfg. Co., Akron, O.
C & C Electric Co., New York.
Commercial Electric Co., Indianapolis, Ind.
Crocker-Wheeler Electric Co., Ampere, N. J.
Eck Dynamo & Motor Co., Belleville, N. J.
General Elec. Co., New York.
Jantz & Leist Elec. Co., Cincin., O.
Mechanical Appliance Co., Milwaukee, Wis.
Northern Elec. Mfg. Co., Madison, Wis.
Robbins & Myers Co., Springfield, Ohio.
Roth Bros. & Co., Chicago, Ill.
Sprague Elec. Co., New York.
Triumph Elec. Co., Cincinnati, O.
Western Electric Co., Chicago, Ill.
Westinghouse Electric & Mfg. Co., Pittsburgh, Pa.

Ejectors
Penberthy Injector Co., Detroit, Mich.

Electrical Supplies
Akron Elec. Mfg. Co., Akron, O.
Commercial Electric Co., Indianapolis, Ind.
Electric Controller & Supply Co., Cleveland, O.
General Elec. Co., New York.
Triumph Electric Co., Cincin., O.
Western Electric Co., Chicago, Ill.
Westinghouse Elec. & Mfg. Co., Pittsburgh, Pa.

Elevators
Albro-Clem Elevator Co., Philadelphia, Pa.
Curtis & Co. Mfg. Co., St. Louis, Mo.
Howard Iron Wks., Buffalo, N. Y.
Morse, Williams & Co., Phila., Pa.

Emery Wheel Dresser
Dickinson, Thos. L., New York.

Emery Wheels
See Grinding Wheels.

Enclosures, Tool-room
Merritt & Co., Philadelphia, Pa.

Engines, Gas and Gasoline
Backus Water Motor Co., Newark, N. J.
Columbus Mach. Co., Columbus, O.
Cooper Mach. Co., Saltsburg, Pa.
Elyria Engine Co., Elyria, O.
Foos Gas Eng. Co., Springfield, O.
Mietz, August, New York.
National Engine Co., Rockford, Ill.
New England Gas Engine Co., Boston, Mass.
New Era Iron Wks., Dayton, O.
Olds Motor Wks., Lansing, Mich.
Patterson, Gottfried & Hunter, Ltd., New York.
Regal Gasoline Engine Co., Coldwater, Mich.
Springfield Gas Eng. Co., Springfield, O.
Stover Engine Works, Freeport, Ill.
Struthers, Wells & Co., Warren, Pa.

Engines, Steam
American Blower Co., Detroit, Mich.
Buffalo Forge Co., Buffalo, N. Y.
Frick Co., Waynesboro, Pa.
Rand Drill Co., New York.
Struthers, Wells & Co., Warren, Pa.

Engine Stop
Consolidated Engine Stop Co., New York.

Exhaust Fans
American Blower Co., Detroit, Mich.
Buffalo Forge Co., Buffalo, N. Y.

Exhaust Heads
Burt Mfg. Co., Akron, O.

Fans, Electric
General Electric Co., New York.
Northern Elec. Mfg. Co., Madison, Wis.
Sprague Elec. Co., New York.
Western Electric Co., Chicago, Ill.
Westinghouse Elec. & Mfg. Co., Pittsburgh, Pa.

Files and Rasps
Barnett Co., G. & H., Phila., Pa.
Etna Mfg. Co., New York.
Hammacher, Schlemmer & Co., New York.
Montgomery & Co., New York.
Nicholson File Co., Provi., R. I.
Troy File Wks., Troy, N. Y.

Filing Machines
Cochrane-Bly Mach. Co., Rochester, N. Y.
Kinsey-Burt Mfg. Co., New York.

Fillers, Oil Can
The Winkley Co., Hartford, Conn.

Filters, Oil
Burt Mfg. Co., Akron, O.

Fittings, Steam
Crane Co., Chicago, Ill.
Crosby Steam Gage & Valve Co., Boston, Mass.
Jenkins Bros., New York.
Lunkenheimer Co., Cincinnati, O.
Walworth Mfg. Co., Boston, Mass.

Flexible Shafts
Chicago Flexible Shaft Co., Chicago, Ill.
Stow Mfg. Co., Binghamton, N. Y.

Forcing Presses
Lucas Machine Tool Co., Cleveland, O.

Forges
Buffalo Forge Co., Buffalo, N. Y.
Miner & Peck Mfg. Co., New Haven, Conn.

Forgings, Drop
Billings & Spencer Co., Hartford, Conn.
Miner & Peck Mfg. Co., New Haven, Conn.
Wyman & Gordon, Worcester, Mass.

Forgings, Hydraulic
Wyman & Gordon, Worcester, Mass.

Forgings, Steel
Westmoreland Steel Co., Pittsburgh, Pa.
Wyman & Gordon, Worcester, Mass.

Foundry Furnishings
Byram & Co., Detroit, Mich.
Diamond Clamp & Flask Works, Richmond, Ind.
Obermayer Co., S., Cincinnati, O.
Smith Fdry. Supply Co., J. D., Cleveland, O.
Paxson Co., J. W., Philadel., Pa.
Whiting Foundry Equip. Co., Harvey, Ill.

Furnaces, Coal, Gas and Oil
Am. Gas Furnace Co., N. Y. City.
Buffalo Forge Co., Buffalo, N. Y.
Chicago Flexible Shaft Co., Chicago, Ill.
Jacobson Mach. Mfg. Co., Warren, Pa.
Westmacott Co., J. M., Prov., R. I.

Furniture, Machine Shop
New Britain Mach. Co., New Britain, Conn.

Gages, Recording
Bristol Co., Waterbury, Conn.

Gages, Steam
Crosby Steam Gage & Valve Co., Boston, Mass.

Gages, Standard
Brown & Sharpe Mfg. Co., Providence, R. I.
Rogers, John M., Boat, Gage & Drill Works, Gloucester City, N. J.
Sawyer Tool Mfg. Co., Fitchburg, Mass.
Slocomb & Co., J. T., Prov., R. I.
Starrett Co., L. S., Athol, Mass.

Gages, Water
Penberthy Injector Co., Detroit, Mich.

Gas Producers
Am. Gas Furnace Co., N. Y. City.

Gear Cutting Machinery
Becker-Brainard Milling Mch. Co., Hyde Park, Mass.
Bickford Drill & Tool Co., Cin., O.
Brown & Sharpe Mfg. Co., Providence, R. I.
Dwight Slate Mach. Co., Hartford, Conn.
Fellows Gear Shaper Co., Springfield, Vt.
Gleason Tool Co., Rochester, N. Y.
Gould & Eberhardt, Newark, N. J.
Harrington & Son Co., Edwin, Philadelphia, Pa.
Newton Mch. Tool Wks., Phil., Pa.
Niles Tool Works Co., New York.
Walcott & Son, Geo. D., Jackson, Mich.
Whiton Machine Co., D. E., New London, Conn.

Gears, Molded
Caldwell & Son Co., H. W., Chicago, Ill.
Farrel Foundry & Mach. Co., Ansonia, Conn.
Franklin Mfg. Co., Syracuse, N. Y.
Greenwald Co., I. & E., Cincin., O.
Poole & Son Co., Robt., Baltimore, Md.

Gears, Cut
Bilgram, Hugo, Philadelphia, Pa.
Boston Gear Wks., Boston, Mass.
Brown & Sharpe Mfg. Co., Providence, R. I.
Cleveland Gear Wks., Cleveland, O.
Fawcus Mach. Co., Pittsburgh, Pa.
Fellows Gear Shaper Co., Springfield, Vt.
Ganschow, Wm., Chicago, Ill.
Gleason Tool Co., Rochester, N. Y.
Gould & Eberhardt, Newark, N. J.
Grant Gear Works, Boston, Mass.
Hardinge Bros., Chicago, Ill.
Harrington, Son & Co., Edwin, Philadelphia, Pa.
Horsburgh & Scott, Cleveland, O.
Messmer Mfg. Co., Ferd., St. Louis, Mo.
New Process Raw Hide Co., Syracuse, N. Y.
N. Y. Gear Works, Brooklyn, N. Y.
Nuttall Co., R. D., Pittsburgh, Pa.
Philadelphia Gear Works, Philadelphia, Pa.
Simonds Mfg. Co., Pittsburgh, Pa.
Walcott & Son, Geo. D., Jackson, Mich.

Gears, Rawhide
Chicago Raw Hide Co., Chicago, Ill.
Fawcus Mch. Co., Pittsburgh, Pa.
Horsburgh & Scott, Cleveland, O.
New Process Raw Hide Co., Syracuse, N. Y.
Nuttall Co., R. D., Pittsburgh, Pa.

Gears, Worm
Albro-Clem Elevator Co., Philadelphia, Pa.
Fawcus Mach. Co., Pittsburgh, Pa.
Morse, Williams & Co., Phila., Pa.
Nuttall Co., R. D., Pittsburgh, Pa.
Simonds Mfg. Co., Pittsburgh, Pa.

Graphite
Dixon Crucible Co., Jos., Jersey City, N. J.
Obermayer Co., S., Cincinnati, O.

Grinders, Cutter
Adams Co., Dubuque, Iowa.
Automatic Mach. Co., Greenfield, Mass.
Becker-Brainard Milling Machine Co., Hyde Park, Mass.
Brown & Sharpe Mfg. Co., Providence, R. I.
Cincinnati Milling Mach. Co., Cincinnati, O.
Garvin Machine Co., New York.
Norton Emery Wheel Co., Worcester, Mass.
Oesterlein Mach. Co., Cincin., O.
Pratt & Whitney Co., Hartford, Conn.
Rivett-Dock Co., Boston, Mass.
Russell, R. M., Binghamton, N. Y.

Grinders, Center
Heald & Son, L. S., Barre, Mass.
Hisey-Wolf Mach. Co., Cincin., O.

Grinders, Cock
Windsor Mach. Co., Windsor, Vt.

Grinders, Disc
Bayldon Mach. & Tool Co., Jersey City, N. J.
Besly & Co., Chas. H., Chicago, Ill.
Gorton Mach. Co., Geo., Racine, Wis.
Iroquois Mach. Co., Provi., R. I.

Grinders, Drill
Gorton Mach. Co., Geo., Racine, Wis.
Heald & Son, L. S., Barre, Mass.
Ransom Mfg. Co., Oshkosh, Wis.
Standard Tool Co., Cleveland, O.
Washburn Shops, Worcester, Mass.
Wilmarth & Morman Co., Grand Rapids, Mich.

Grinders, Saw
Keystone Machine Tool Works, Philadelphia, Pa.

Grinders, Tool
Barnes Co., B. F., Rockford, Ill.
Barnes Co., W. F. & John, Rockford, Ill.
Brown & Sharpe Mfg. Co., Providence, R. I.
Diamond Mach. Co., Prov., R. I.
Dwight Slate Mach. Co., Hartford, Conn.
Gisholt Mach. Co., Madison, Wis.
Iroquois Mach. Co., Provi., R. I.
Landis Tool Co., Waynesboro, Pa.
Modern Tool Co., Erie, Pa.
Northampton Emery Wheel Co., Leeds, Mass.
Oesterlein Mach. Co., Cincin., O.
Ransom Mfg. Co., Oshkosh, Wis.
Safety Emery Wheel Co., Springfield, O.
Whitney Mfg. Co., Hartford, Ct.

Grinding Machines
Besly & Co., Chas. H., Chicago, Ill.
Blount & Co., J. G., Everett, Mass.
Brown & Sharpe Mfg. Co., Providence, R. I.
Builders' Iron Foundry, Providence, R. I.
Diamond Mach. Co., Prov., R. I.
Falkenau-Sinclair Co., Phila., Pa.
Frasse Co., New York.
Goodell-Pratt Co., Greenfield, Mass.
Gorton Mach. Co., Geo., Racine, Wis.
Greenfield Mach. Co., Greenfield, Mass.
Hill, Clarke & Co., Boston, Mass.
Hisey-Wolf Mach. Co., Cincin., O.
Iroquois Mach. Co., Prov., R. I.
Landis Tool Co., Waynesboro, Pa.
Marshall & Huschart Mchry. Co., Chicago, Ill.
Marshall & Huschart Mchry. Co., Cleveland, O.
Northampton Emery Wheel Co., Leeds, Mass.
Northern Elec. Mfg. Co., Madison, Wis.
Norton Emery Wheel Co., Worcester, Mass.
Prentiss Tool & Supply Co., New York.
Ransom Mfg. Co., Oshkosh, Wis.
Russell, R. M., Binghamton, N. Y.
Safety Emery Wheel Co., Springfield, Ohio.
Tanite Co., Stroudsburg, Pa.
Vitrified Wheel Co., Westfield, Mass.
Washburn Shops, Worcester, Mass.
Webster & Perks Tool Co., Springfield, O.
Wilmarth & Morman Co., Grand Rapids, Mich.

Grinding Wheels
Abrasive Material Co., Phila., Pa.
Builders' Iron Foundry, Providence, R. I.
Carborundum Co., Niagara Falls, N. Y.
Diamond Mach. Co., Provi., R. I.
Hampden Cor. Wheel Co., Brightwood, Mass.
Montgomery & Co., New York.
Northampton Emery Wheel Co., Leeds, Mass.
Norton Emery Wheel Co., Worcester, Mass.
Safety Emery Wheel Co., Springfield, O.
Tanite Co., Stroudsburg, Pa.
Vitrified Wheel Co., Westfield, Mass.

Grindstones
Lombard & Co., Boston, Mass.

Gun Barrel Machinery
Bement, Miles & Co., New York.
Diamond Mach. Co., Provl., R. I.
Niles Tool Works Co., New York.
Pond Mach. Tool Co., New York.
Reed Co., F. E., Worcester, Mass.

Hack Saw Blades and Frames
Diamond Saw & Stamping Works, Buffalo, N. Y.
Goodell-Pratt Co., Greenfield, Mass.
Hammacher, Schlemmer & Co., New York.
Millers Falls Co., New York.
Starrett Co., L. S., Athol, Mass.
West Haven Mfg. Co., New Haven, Conn.

Hack Saws, Power
Diamond Saw & Stamping Works, Buffalo, N. Y.
Frasse Co., New York.
Hoefer Mfg. Co., Freeport, Ill.
Millers Falls Co., New York.
Olmsted, L. H., Hasbrouck Heights, N. J.
West Haven Mfg. Co., New Haven, Conn.

Hammers, Drop
Bement, Miles & Co., New York.
Billings & Spencer Co., Hartford, Conn.
Bliss Co., E. W., Brooklyn, N. Y.
Iroquois Machine Co., Providence, R. I.
Miner & Peck Mfg. Co., New Haven, Conn.
Mossberg & Granville Mfg. Co., Providence, R. I.
Perkins Mach. Co., Boston, Mass.
Williams, White & Co., Moline, Ill.

Hammers, Pneumatic
Chicago Pneumatic Tool Co., Chicago, Ill.
Cleveland Pneumatic Tool Co., Cleveland, O.
Dallett & Co., Thos. H., Phila., Pa.
Phila. Pneu. Tool Co., Philadelphia, Pa.
Q. & C. Co., Chicago, Ill.
Standard Ry. Equip. Co., St. Louis, Mo.

Hammers, Power
Scranton & Co The, New Haven, Conn.

Hammers, Steam
Bement, Miles & Co., New York.
Bethlehem Fdry. & Mach. Co., So. Bethlehem, Pa.
Chambersburg Engineering Co., Chambersburg, Pa.
Cleveland Punch & Shear Wks. Co., Cleveland, O.
Pittsburg Shear Knife & Mach. Co., Pittsburg, Pa.

Handles, Machine Tool
Norwood Mach. & Mfg. Co., Cincinnati, O.

Heating Machines, Automatic
Am. Gas Furnace Co., New York.

Heating and Ventilating Apparatus
American Blower Co., Detroit, Mich.
Buffalo Forge Co., Buffalo, N. Y.

Hoisting and Conveying Machinery
Brown Hoisting Mchry. Co., New York.
Caldwell & Son Co., H. W., Chicago, Ill.
Eastern Mchry. Co., New Haven, Conn.
Hunt Co., C. W., West New Brighton, N. Y.
Link Belt Engineering Co., Philadelphia, Pa.
Moyer & Co., J. W., Philadel., Pa.
Niles-Bement-Pond Co., New York.

Hoists, Electric
C & C Electric Co., New York.
Hunt Co., C. W., West New Brighton, N. Y.
Northern Engineering Works, Detroit, Mich.
Pawling & Harnischfeger, Milwaukee, Wis.
Sprague Electric Co., New York.

Hoists, Hand
Harrington, Son & Co., Edwin, Philadelphia, Pa.
Moyer & Co., J. W., Philadel., Pa.
Yale & Towne Mfg. Co., New York.

Hoists, Pneumatic
Chicago Pneumatic Tool Co., Chicago, Ill.
Cleveland Pneumatic Tool Co., Cleveland, O.
Curtis & Co. Mfg. Co., St. Louis, Mo.
Northern Engineering Wks., Detroit, Mich.
Rand Drill Co., New York.

Igniters, Gas Engine
Maxwell Engr. Co., Rome, N. Y.

Indicators, Speed
Starrett Co., L. S., Athol, Mass.
Woodman Mfg. & Supply Co., R., Boston, Mass.

Indicators, Steam
Crosby Steam Gage & Valve Co., Boston, Mass.

Indicators, Test
Lowe, H. A., Waltham, Mass.

Injectors
Lunkenheimer Co., Cincinnati, O.
Penberthy Injector Co., Detroit, Mich.
Rue Mfg. Co., Philadelphia, Pa.
Sellers & Co., Wm., Phila., Pa.

Inspection and Tests
Hunt Co., Robt. W., Chicago, Ill.

Instruction Schools
See Schools, Correspondence.

Jacks, Hydraulic
Bethlehem Fdry & Mch. Co., So. Bethlehem, Pa.
Wallace Supply Co., Chicago, Ill.
Watson-Stillman Co., New York.

Key Seaters
Baker Bros., Toledo, O.
Bement, Miles & Co., New York.
Chattanooga Mchry. Co., Chattanooga, Tenn.
Davis Mach. Co., W. P., Rochester, N. Y.
Hill Tool Co., Anderson, Ind.
Mitts & Merrill, Saginaw, Mich.

Keys, Machine
Standard Gauge Steel Co., Beaver Falls, Pa.
Whitney Mfg. Co., Hartford, Ct.

Lamps, Arc
General Electric Co., N. Y. City.
Western Electric Co., Chicago, Ill.
Westinghouse Elec. & Mfg. Co., Pittsburgh, Pa.

Lathes
American Tool Wks. Co., Cin., O.
Auto. Mach. Co., Bridgeport, Ct.
Automatic Mach. Co., Greenfield, Mass.
Barker & Co., Wm., Cincin., O.
Barnes Co., B. F., Rockford, Ill.
Barnes Co., W. F. & John, Rockford, Ill.
Bement, Miles & Co., New York.
Blaisdell & Co., P., Worcester, Mass.
Blount & Co., J. G., Everett, Mass.
Bradford Mach. Tool Co., Cin., O.
Bullard Mach. Tool Co., Bridgeport, Conn.
Davis Mach. Co., W. P., Rochester, N. Y.
Diamond Machine Co., Provl., R. I.
Falkenau-Sinclair Co., Phila., Pa.
Fay & Scott, Dexter, Me.
Flather & Co., Nashua, N. H.
Frasse Co., New York.
Garvin Mach. Co., New York.
Greaves, Klusman & Co., Cin., O.
Harrington, Son & Co., Edwin, Philadelphia, Pa.
Hendey Mach. Co., Torrington, Ct.
Hill, Clarke & Co., Boston, Mass.
Le Blond Mach. Tool Co., R. K., Cincinnati, O.
Lodge & Shipley Mch. Tool Co., Cincinnati, O.
McCabe, J. J., Nw York.
Marshall & Huschart Mchry. Co., Chicago, Ill.
Marshall & Huschart Mchry. Co., Cleveland, O.
New Haven Mfg. Co., New Haven, Conn.
Niles Tool Works Co., New York.
Pond Mach. Tool Co., New York.
Pratt & Whitney Co., Hartford, Conn.
Prentice Bros. Co., Worcester, Mass.
Prentiss Tool & Supply Co., New York.
Reed Co., F. E., Worcester, Mass.

Lathes—*Continued*
Schumacher & Boye, Cincinnati, Ohio.
Sebastian Lathe Co., Cincin., O.
Seneca Falls Mfg. Co., Seneca Falls, N. Y.
Shepard Lathe Co., Cincinnati, O.
Tanite Co., Stroudsburg, Pa.
Walcott & Son, Geo. D., Jackson, Mich.
Washburn Shops, Worcester, Mass.

Lathe Attachments
Bayldon Mach. & Tool Co., Jersey City, N. J.

Lathe Dogs
Armstrong Bros. Tool Co., Chicago, Ill.
Besly & Co., Chas. H., Chicago, Ill.
Hill Tool Co., Anderson, Ind.
Le Count, Wm. G., So. Norwalk, Conn.
Montgomery & Co., New York.
Pratt & Whitney Co., Hartford, Conn.

Lathes, Automatic Screw-Threading
Automatic Machine Co., Bridgeport, Conn.

Lathes, Bench
Faneuil Watch Tool Co., Boston, Mass.
Fenn-Sadler Mach. Co., Hartford, Conn.
Gump & Co., A. W., Dayton, O.
Waltham Watch Tool Co., Springfield, Mass.

Lathes, Wood
American Machinery Co., Grand Rapids, Mich.

Letters, Pattern
Butler, A. G., N. Y. City.

Levels
Mass. Tool Co., Greenfield, Mass.
Starrett Co., L. S., Athol, Mass.

Lockers, Clothes
Merritt & Co., Philadelphia, Pa.
Narragansett Mach. Co., Providence, R. I.

Locomotives, Shop
Hunt Co., C. W., West New Brighton, N. Y.

Lubricants
Besly & Co., Chas. H., Chicago, Ill.
Dixon Crucible Co., Jos., Jersey City, N. J.

Lubricators
Besly & Co., Chas. H., Chicago, Ill.
Bowen Mfg. Co., Auburn, N. Y.
Crane Co., Chicago, Ill.
Lunkenheimer Co., Cincinnati, O.
Penberthy Injector Co., Detroit, Mich.

Machine Screws
Atlantic Mach. Screw Co., Boston, Mass.
Worcester Mach. Screw Co., Worcester, Mass.

Machinery Builders, Special
American Fdry. & Mach. Co., Hanover, Pa.
Atlas Foundry & Mach. Co., Belleville, N. J.
Blanchard Mach. Co., The, Boston, Mass.
Fawcus Mch. Co., Pittsburgh, Pa.
Gardam & Son, Wm., New York.
Lucas Mach. Tool Co., Cleveland, Ohio.
National Mchry. Co., Tiffin, O.
Pratt & Whitney Co., Hartford, Conn.
Simonds Mfg. Co., Pittsburgh, Pa.

Machinists' Small Tools
Besly & Co., Chas. H., Chicago, Ill.
Billings & Spencer Co., Hartford, Conn.
Brown & Sharpe Mfg. Co., Providence, R. I.
Cleveland Twist Drill Co., Cleveland, O.
Hammacher, Schlemmer & Co., New York.
Mass. Tool Co., Greenfield, Mass.
McCrosky & Huber, Cincinnati, O.
Montgomery & Co., New York.
Patterson, Gottfried & Hunter, Ltd., New York.
Sawyer Tool Mfg. Co., Fitchburg, Mass.
Slocomb & Co., J. T., Provi., R. I.
Starrett Co., L. S., Athol, Mass.

Mandrels, Expanding
Nicholson & Son, W. H., Wilkesbarre, Pa.

Mandrels, Solid
Cleveland Twist Drill Co., Cleveland, O.
Morse Twist Drill & Mach. Co., New Bedford, Mass.
Rogers, John M., Boat, Gage & Drill Works, Gloucester City, N. J.
Standard Tool Co., Cleveland, O.

Marking Machines
Dwight Slate Mach. Co., Hartford, Conn.

Measuring Machines
Rogers, John M., Boat, Gage & Drill Works, Gloucester City, N. J.

Micrometer Calipers
Brown & Sharpe Mfg. Co., Providence, R. I.
Sawyer Tool Mfg. Co., Fitchburg, Mass.
Slocomb & Co., J. T., Providence, R. I.
Starrett Co., L. S., Athol, Mass.

Milling Attachments
The Adams Co., Dubuque, Iowa.
Becker-Brainard Milling Machine Co., Hyde Park, Mass.
Brown & Sharpe Mfg. Co., Providence, R. I.
Cincinnati Milling Mach. Co., Cincinnati, O.
Kempsmith Mfg. Co., Milwaukee, Wis.
Oesterlein Mach. Co., Cincin., O.

Milling Machines, Bench
Faneuil Watch Tool Co., Boston, Mass.
Hill, Clarke & Co., Boston, Mass.
Waltham Watch Tool Co., Springfield, Mass.

Milling Machines, Horizontal
Adams Co., Dubuque, Iowa.
Beaman & Smith Co., Prov., R. I.
Becker-Brainard Milling Machine Co., Hyde Park, Mass.
Bement, Miles & Co., New York.
Franklin Mach. Wks., Phila., Pa.
Hendey Mach. Co., Torrington, Ct.
Ingersoll Mill. Mach. Co., Rockford, Ill.
Newton Mach. Tool Wks., Philadelphia, Pa.
Niles Tool Works Co., New York.
Pratt & Whitney Co., Hartford, Conn.

Milling Machines, Plain
American Tool Wks. Co., Cin., O.
Aurora Tool Wks., Aurora, Ind.
Bement, Miles & Co., New York.
Becker-Brainard Milling Machine Co., Hyde Park, Mass.
Brown & Sharpe Mfg. Co., Providence, R. I.
Cincinnati Milling Mach. Co., Cincinnati, O.
Dwight Slate Mach. Co., Hartford, Conn.
Garvin Mach. Co., New York.
Hendey Mach. Co., Torrington, Ct.
Hill, Clarke & Co., Boston, Mass.
Kempsmith Mfg. Co., Milwaukee, Wis.
Le Blond Mach. Tool Co., R. K., Cincinnati, O.
Marshall & Huschart Mchry Co., Chicago, Ill.
Marshall & Huschart Mchry. Co., Cleveland, O.
McCabe, J. J., New York.
Oesterlein Mach. Co., Cincin., O.
Owen Mach. Tool Co., Springfield, Ohio.
Prentiss Tool & Supply Co., New York.
Whitney Mfg. Co., Hartford, Ct.

Milling Machines, Portable
Underwood & Co., H. B., Philadelphia, Pa.

Milling Machines, Vertical
Becker-Brainard Milling Machine Co., Hyde Park, Mass.
Bement, Miles & Co., New York.
Brown & Sharpe Mfg. Co., Providence, R. I.
Garvin Mach. Co., New York.
Ingersoll Mill. Mach. Co., Rockford, Ill.
Newton Mch. Tool Works, Philadelphia, Pa.
Niles Tool Works Co., New York.
Owen Mach. Tool Co., Springfield, Ohio.
Pratt & Whitney Co., Hartford, Conn.

Milling Machines, Universal
American Tool Wks. Co., Cin., O.
Aurora Tool Wks., Aurora, Ind.
Becker-Brainard Milling Machine Co., Hyde Park, Mass.
Bement, Miles & Co., New York.
Brown & Sharpe Mfg. Co., Providence, R. I.
Cincinnati Milling Mach. Co., Cincinnati, O.
Garvin Mach. Co., New York.
Hendey Mach. Co., Torrington, Ct.
Hill, Clarke & Co., Boston, Mass.
Kempsmith Mfg. Co., Milwaukee, Wis.
Le Blond Mach. Tool Co., R. K., Cincinnati, O.
Marshall & Huschart Mchry. Co., Chicago, Ill.
Marshall & Huschart Mchry. Co., Cleveland, O.
McCabe, J. J., New York.
Niles Tool Works Co., New York.
Oesterlein Mach. Co., Cincin., O.
Owen Mach. Tool Co., Springfield, Ohio.
Prentiss Tool & Supply Co., New York.
Waltham Watch Tool Co., Springfield, Mass.

Milling Tools, Adjustable
Geometric Drill Co., New Haven, Conn.
Rogers, Boat, Gage & Drill Wks., John M., Gloucester City, N. J.

Molding Machines
The Adams Co., Dubuque, Iowa.
American Foundry & Mach. Co., Hanover, Pa.
Tabor Mfg. Co., Philadelphia, Pa.
Webster & Perks Tool Co., Springfield, O.

Motors, Electric
Akron Elec. Mfg. Co., Akron, O.
Commercial Electric Co., Indianapolis, Ind.
C & C Electric Co., New York.
Christensen Engr. Co., Milwaukee, Wis.
Crocker-Wheeler Co., Ampere, N. J.
Eck Dynamo & Motor Wks., Belleville, N. J.
General Electric Co., New York.
Jantz & Leist Elec. Co., Cin., O.
Mechanical Appliance Co., Milwaukee, Wis.
Northern Elec. Mfg. Co., Madison, Wis.
Robbins & Myers Co., Springfield, Ohio.
Roth Bros. & Co., Chicago, Ill.
Sprague Electric Co., New York.
Stow Mfg. Co., Binghamton, N. Y.
Triumph Elec. Co., Cincinnati, O.
Western Electric Co., Chicago, Ill.
Westinghouse Elec. & Mfg. Co., Pittsburgh, Pa.

Nail Machinery, Wire
National Machy. Co., Tiffin, O.

Name Plates
Franklin Mfg. Co., Syracuse, N. Y.
Murdock Parlor Grate Co., Boston, Mass.

Nut Tappers
See Bolt and Nut Machinery.

Oils
Besly & Co., Chas. H., Chicago, Ill.
Houghton & Co., E. F., Philadelphia, Pa.

Oil Cans, Pump
Wallace Supply Co., Chicago, Ill.

Oil Cups and Covers
Bay State Stamping Works, Worcester, Mass.
Besly & Co., Chas. H., Chicago, Ill.
Bowen Mfg. Co., Auburn, N. Y.
Crane Co., Chicago, Ill.
Lunkenheimer Co., Cincinnati, O.
Penberthy Injector Co., Detroit, Mich.
The Winkley Co., Hartford, Conn.

Packing, Steam Joint
Jenkins Bros., New York.

Paint
Hook, F. E., Hudson, Mich.
Wallace Supply Co., Chicago, Ill.

Painting Machines
Hook, F. E., Hudson, Mich.

Pans, Lathe
New Britain Mch. Co., New Britain, Conn.

Patents
Baldwin, Davidson & Wight, Washington, D. C.
Straley, Hasbrouck & Schloeder, New York.

Pattern Shop Machinery & Supplies
American Machinery Co., Grand Rapids, Mich.
Baker Bros., Toledo, O.
Diamond Clamp & Flask Wks., Richmond, Ind.
Fay & Scott, Dexter, Me.
Greaves, Klusman & Co., Cin., O.
Machinery Exchange, Chicago, Ill.
Marston & Co., J. M., Boston, Mass.
Prentiss Tool & Supply Co., New York.
Washburn Shop, Worcester, Mass.

Patterns, Wood
Gobeille Pattern Co., Cleveland, O.
Olmstead Co., H. B., New York.

Pencils
Keuffel & Esser Co., New York.

Phosphor Bronze
Phosphor Bronze Smelting Co., Philadelphia, Pa.

Pipe and Fittings
Crane Co., Chicago, Ill.

Pipe Cutting and Threading Machines
Bignall & Keeler Mfg. Co., Edwardsville, Ill.
Curtis & Curtis Co., Bridgeport, Conn.
Merrell Mfg. Co., Toledo, O.
Saunders' Sons, D., Yonkers, N. Y.
Wells Bros. Co., Greenfield, Mass.

Pipe Fitters' Tools
Cleveland Twist Drill Co., Cleveland, O.
Saunders' Sons, D., Yonkers, N. Y.
Standard Tool Co., Cleveland, O.

Planer, Jack
Armstrong Bros. Tool Co., Chicago, Ill.

Planers
American Tool Wks. Co., Cin., O.
Belmer Mach. Tool Co., Cin., O.
Bement, Miles & Co., New York.
Betts Mach. Co., Wilmington, Del.
Cincinnati Planer Co., Cincin., O.
Detrick & Harvey Mch. Co., Baltimore, Md.
Flather Planer Co., Mark, Nashua, N. H.
Garvin Mach. Co., New York.
Gray Co., G. A., Cincinnati, O.
Harrington, Son & Co., Edwin, Philadelphia, Pa.
Hendey Mach. Co., Torrington, Ct.
Hill, Clarke & Co., Boston, Mass.
McCabe, J. J., New York.
Niles Tool Works Co., New York.
New Haven Mfg. Co., New Haven, Conn.
Pond Mach. Tool Co., New York.
Prentiss Tool & Supply Co., New York.
Sellers & Co., Wm., Phila., Pa.
Whitcomb Mfg. Co., Worcester, Mass.
Woodward & Powell Planer Co., Worcester, Mass.

Planers, Bench
Bartlett, E. E., Boston, Mass.

Planers, Portable
Morton Mfg. Co., Muskegon Heights, Mich.
Underwood & Co., H. B., Philadelphia, Pa.

Planers, Rotary
Bement, Miles & Co., New York.
Cleveland Punch & Shear Works, Cleveland, O.
Franklin Mach. Wks., Phila., Pa.
Keystone Machine Tool Works, Philadelphia, Pa.
Newton Mach. Tool Wks., Philadelphia, Pa.
Pond Mach. Tool Co., New York.
Underwood & Co., H. B., Philadelphia, Pa.

Presses, Hydraulic
Bement, Miles & Co., New York.
Elmes Engr. Wks., Chas. F., Chicago, Ill.
Watson-Stillman Co., New York.

Presses, Power
Automatic Mach. Co., Bridgeport, Conn.
Bethlehem Fdry. & Mch. Co., So. Bethlehem, Pa.
Bliss Co., E. W., Brooklyn, N. Y.
Dill Mach. Co., T. C., Phila., Pa.
Falkenau-Sinclair Co., Phila., Pa.
Mossberg & Granville Mfg. Co., Providence, R. I.
Perkins Mach. Co., Boston, Mass.
Prentiss Tool & Supply Co., New York.
Wold & Co., Torris, Chicago, Ill.

Presses, Hand
Elmes Engr. Wks., Chas. F., Chicago, Ill.

Profilers
Garvin Mach. Co., New York.
Pratt & Whitney Co., Hartford, Conn.

Pulley Turning and Boring Machines
American Tool Wks. Co., Cin., O.
Harrington, Son & Co., Edwin, Philadelphia, Pa.
New Haven Mfg. Co., New Haven, Conn.
Niles Tool Works Co., New York.

Pulleys
American Pulley Co., Phila., Pa.
Caldwell & Son Co., H. W., Chicago, Ill.
Cresson Co., Geo. V., Phila., Pa.
Howard Iron Wks., Buffalo, N. Y.
Poole & Son Co., Robt., Baltimore, Md.
Reeves Pulley Co., Columbus, Ind.

Pulleys, Friction Cone
Evans Friction Cone Co., Boston, Mass.

Pulleys, Speed Changing
Speed Changing Pulley Co., Indianapolis, Ind.

Pumps, Hydraulic
Elmes Engr. Wks., Chas. F., Chicago, Ill.
Watson-Stillman Co., New York.

Punches, Hydraulic
Bement, Miles & Co., New York.
Bethlehem Fdry. & Mch. Co., So. Bethlehem, Pa.
Watson-Stillman Co., New York.

Punches, Power
Bliss Co., E. W., Brooklyn, N. Y.
Bremer Mach. & Tool Co., Kalamazoo, Mich.
Buffalo Forge Co., Buffalo, N. Y.
Cleveland Punch & Shear Wks., Cleveland, O.
Hilles & Jones Co., Wilmington, Del.
Long & Allstatter Co., Hamilton, Ohio.
Perkins Mach. Co., So. Boston, Mass.
Pittsburg Shear Knife & Mach. Co., Pittsburg, Pa.
Reade Mchry Co., Cleveland, O.
Williams, White & Co., Moline, Ill.

Rack Cutting Machines
Dwight Slate Mach. Co., Hartford, Conn.
Fellows Gear Shaper Co., Springfield, Vt.
Le Blond Mach. Tool Co., R. K., Cincinnati, O.
Reed Co., F. E., Worcester, Mass.
Walcott & Son, Geo. D., Jackson, Mich.

Racks, Cut
Fellows Gear Shaper Co., Springfield, Vt.
Nuttall Co., R. D., Pittsburgh, Pa.
Simonds Mfg. Co., Pittsburgh, Pa.
Standard Gauge Steel Co., Beaver Falls, Pa.
Walcott & Son, Geo. D., Jackson, Mich.

Racks, Tool
New Britain Mach. Co., New Britain, Conn.

Ram, Steam
Penberthy Injector Co., Detroit, Mich.

Reamers
Chadwick & Co., G. B., Portsmouth, N. H.
Cleveland Twist Drill Co., Cleveland, O.
Clough, R. M., Tolland, Conn.
McCrosky & Huber, Cincinnati, O.
Montgomery & Co., New York.
Morse Twist Drill & Mach. Co., New Bedford, Mass.
Pratt & Whitney Co., Hartford, Conn.
Rogers, John M., Boat, Gage & Drill Works, Gloucester City, N. J.
Standard Tool Co., Cleveland, O.
Wells Bros. Co., Greenfield, Mass.

Reaming Stands
Flather Planer Co., Mark, Nashua, N. H.

Riveters, Hydraulic
Bement, Miles & Co., New York.
Watson-Stillman Co., New York.

Riveters, Pneumatic
Bement, Miles & Co., New York.
Cleveland Pneumatic Tool Co., Cleveland, O.
Philadelphia Pneumatic Tool Co., Philadelphia, Pa.
Q & C Co., Chicago, Ill.
Standard Ry. Equip. Co., St. Louis, Mo.

Riveting Machines
Bement, Miles & Co., New York.
Bethlehem Foundry & Mach. Co., So. Bethlehem, Pa.
Chambersburg Engr. Co., Chambersburg, Pa.
Long & Allstatter Co., Hamilton, Ohio.
Perkins Mach. Co., So. Boston, Mass.

Rods and Straps, Connecting
Standard Connecting Rod Co., Beaver Falls, Pa.

Roller and Ball Bearings
American Roller Bearing Co., Boston, Mass.
Ball Bearing Co., Philadel., Pa.
Iroquois Mach. Co., Providence, R. I.
Mossberg & Granville Mfg. Co., Providence, R. I.

Rolling Mill Machinery
Cleveland Punch & Shear Wks. Co., Cleveland, O.
Diamond Drill & Mch. Co., Birdsboro, Pa.
Dill Mach. Co., T. C., Phila., Pa.
Hilles & Jones Co., Wilmington, Del.
Iroquois Mach. Co., Providence, R. I.
Mossberg & Granville Mfg. Co., Providence, R. I.
Pratt & Whitney Co., Hartford, Conn.

Rolls, Bending
Perkins Mach. Co., So. Boston, Mass.

Safety Valves, Pop
Crane Co., Chicago, Ill.
Crosby Steam Gage & Valve Co., Boston, Mass.
Lunkenheimer Co., Cincinnati, O.

Sand Blast Apparatus
Paxson Co., J. W., Philadel., Pa.

Sand Mixing Machines
Smith Fdry. Supply Co., J. D., Cleveland, O.

Sawing Machines, Metal
Cleveland Punch & Shear Works Co., Cleveland, O.
Cochrane-Bly Mach. Works, Rochester, N. Y.
Keystone Mach. Tool Wks., Philadelphia, Pa.
Marston & Co., J. M., Boston, Mass.
Newton Mach. Tool Works, Philadelphia, Pa.
Nutter, Barnes & Co., Boston, Mass.
Pratt & Whitney Co., Hartford, Conn.
Reade Mchry. Co., Cleveland, O.
West Haven Mfg. Co., New Haven, Conn.

Sawing Machines, Wood
American Machinery Co., Grand Rapids, Mich.

Schools, Correspondence
Amer. School of Correspondence, Boston, Mass.
Consolidated Schools, N. Y. City.
International Correspond. Schools, Scranton, Pa.

Screw Machines, Hand
Brown & Sharpe Mfg. Co., Providence, R. I.
Cleveland Automatic Mach. Co., Cleveland, O.
Garvin Mach. Co., New York.
Jones & Lamson Mch. Co., Springfield, Vt.
Pearson Mach. Co., Chicago, Ill.
Potter & Johnston Mach. Co., Pawtucket, R. I.
Pratt & Whitney Co., Hartford, Conn.
Warner & Swasey Co., Cleveland, Ohio.
Windsor Mach. Co., Windsor, Vt.

Screw Machinery, Wood and Lag
Baker Bros., Toledo, Ohio.
Cook Co., Asa S., Hartford, Conn.

Screw Machines, Automatic
Brown & Sharpe Mfg. Co., Providence, R. I.
Cleveland Automatic Mach. Co., Cleveland, Ohio.
Dreses Mach. Tool Co., Cincin., O.
Marshall & Huschart Mchry. Co., Chicago, Ill.
Marshall & Huschart Mchry. Co., Cleveland, O.
Windsor Mach. Co., Windsor, Vt.

Screw Plates
Besly & Co., Chas. H., Chicago, Ill.
Carpenter Tap & Die Co., J. M., Pawtucket, R. I.
Card Mfg. Co., S. W., Mansfield, Mass.
Hart Mfg. Co., Cleveland, O.
Morse Twist Drill & Mach. Co., New Bedford, Mass.
Wells Bros. Co., Greenfield, Mass.
Wiley & Russell Mfg. Co., Greenfield, Mass.

Second Hand Machinery
Affleck, Geo. E., New York.
Baird Machy. Co., Pittsburgh, Pa. Pa.
Bowler & Co., Geo. H., Cleveland, Ohio.
Carlin Mchry. & Supply Co., Allegheny, Pa.
Dawson, John H., Chicago, Ill.
Fairbanks Co., Philadelphia, Pa.
Garvin Mch. Co., New York.
Gump & Co., A. W., Dayton, O.
Hill, Clarke & Co., Boston, Mass.
Marshall & Huschart Mchry. Co., Chicago, Ill.
Marshall & Huschart Mchry. Co., Cleveland, O.
McCabe, J. J., New York.
Niles Tool Works Co., New York.
Pratt & Whitney Co., Hartford, Conn.
Prentiss Tool & Supply Co., New York.
Toomey, Frank, Philadelphia, Pa.
Wormer Machy. Co., C. C., Detroit, Mich.

Separators, Magnetic
Sawyer, Ezra, Worcester, Mass.

Separators, Oil
American Tool & Mach. Co., Boston, Mass.
Springfield Separator Co., Manchester, N. H.

Shafts, Crank
Standard Connecting Rod Co., Beaver Falls, Pa.

Shapers
American Tool Wks. Co., Cin. O.
Barker & Co., Wm., Cincinnati, O.
Bement, Miles & Co., New York.
Blount & Co., J. G., Everett, Mass.
Cincinnati Shaper Co., Cincin., O.
Flather Planer Co., Mark, Nashua, N. H.
Garvin Mach. Co., New York.
Hendey Mch. Co., Torrington, Ct.
Gould & Eberhardt, Newark, N. J.
Hill, Clarke & Co., Boston, Mass.
Kelly Co., R. A., Xenia, Ohio.
Marshall & Huschart Mchry. Co., Chicago, Ill.
Marshall & Huschart Mchry. Co., Cleveland, O.
Morton Mfg. Co., Muskegon Heights, Mich.
New Haven Mfg. Co., New Haven, Conn.
Niles Tool Works Co., New York.
Perkins Mach. Co., Boston, Mass.
Potter & Johnston Mach. Co., Pawtucket, R. I.
Smith & Mills, Cincinnati, O.
Steptoe & Co., John, Cincinnati, O.
Walcott & Son, Geo. D., Jackson, Mich.

Shapers, Vertical Die
Rochester Die Shaper Co., Rochester, N. Y.

Shears, Power
Bethlehem Fdry. & Mch. Co., So. Bethlehem, Pa.
Bliss Co., E. W., Brooklyn, N. Y.
Bremer Mach. & Tool Co., Kalamazoo, Mich.
Buffalo Forge Co., Buffalo, N. Y.
Cleveland Punch & Shear Works, Cleveland, O.
Falkenau-Sinclair Co., Phila., Pa.
Hilles & Jones Co., Wilmington, Del.
Long & Allstatter Co., Hamilton, Ohio.
National Mchry. Co., Tiffin, O.
Perkins Mach. Co., Boston, Mass.
Pittsburg Shear Knife & Mach. Co., Pittsburg, Pa.
Reade Mchry Co., Cleveland, O.
Williams, White & Co., Moline, Ill.

Shears, Rotary
Bethlehem Foundry & Mach. Co., So. Bethlehem, Pa.
Detrick & Harvey Mach. Co., Baltimore, Md.
Perkins Mach. Co., So. Boston, Mass.

Shelving, Shop
New Britain Mach. Co., New Britain, Conn.

Slide Rests
Bartlett, E. E., Boston, Mass.
Reed Co., F. E., Worcester, Mass.

Slotters
Baker Bros., Toledo, Ohio.
Bement, Miles & Co., New York.
Betts Mach. Wks., Wilmington, Del.
Dill Mach. Co., T. C. Phila., Pa.
Dwight Slate Mach. Co., Hartford, Conn.
Franklin Mach. Wks., Phila., Pa.
Garvin Mach. Co., New York.
New Haven Mfg. Co., New Haven, Conn.
Newton Mach. Tool Wks., Philadelphia, Pa.
Niles Tool Works Co., New York.

Speed Limit System
Consolidated Engine Stop Co., New York.

Spike Machines
National Machy. Co., Tiffin, O.

Springs
Dunbar Bros., Bristol, Conn.

Sprocket Chains
See Driving Chains.

Stampings, Sheet Steel
Federal Mfg. Co., Cleveland, O.

Stamps, Steel
The Chandler Co., Springfield, Mass.
Schwerdtle Stamp Co., Bridgeport, Conn.

Steel, Machinery
Boker & Co., Hermann, New York.
International Steel & Mchry. Co., New York.
Patriarche & Bell, New York.
Ward & Son, Edgar T., Boston, Mass.

Steel, Sheet
Federal Mfg. Co., Cleveland, O.
Ward & Son, Edgar T., Boston, Mass.

Steel, Tool
Boker & Co., Hermann, New York.
International Steel & Mach. Co., New York.
Patriarche & Bell, New York.
Westmoreland Steel Co., Pittsburg, Pa.

Straightener, Hydraulic
Bement, Miles & Co., New York.
Watson-Stillman Co., New York.

Swaging Machines
Excelsior Needle Co., Torrington, Conn.
Iroquois Mach. Co., Provi., R. I.
Mossberg & Granville Mfg. Co., Providence, R. I.

Switchboards
C & C Electric Co., New York.
Electric Controller & Supply Co., Cleveland, O.
Triumph Elec. Co., Cincinnati, O.

Tapping Machines and Attachments
Baker Bros., Toledo, O.
The Beaman & Smith Co., Providence, R. I.
Bickford Drill & Tool Co., Cin., O.
Cincinnati Mach. Tool Co., Cincinnati, O.
Dwight Slate Mach. Co., Hartford, Conn.
Errington, F. A., N. Y. City.
Fosdick Mach. Tool Co., Cin., O.
Garvin Mach. Co., New York.
Geometric Drill Co., New Haven, Conn.
National Mchry. Co., Tiffin, O.
Pratt & Whitney Co., Hartford, Conn.
Seneca Falls Mfg. Co., Seneca Falls, N. Y.
Webster & Perks Tool Co., Springfield, O.

Taps, Collapsing
Geometric Drill Co., New Haven, Conn.

Taps and Dies
Besly & Co., Chas. H., Chicago, Ill.
Card Mfg. Co., S. W., Mansfield, Mass.
Carpenter Tap & Die Co., J. M., Pawtucket, R. I.
Cleveland Twist Drill Co., Cleveland, O.
Crane Co., Chicago, Ill.
Hammacher, Schlemmer & Co., New York.
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Rivett-Dock Co., Boston, Mass.

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Hill Tool Co., Anderson, Ind.
Hoggson & Pettis Mfg. Co., New Haven, Conn.
McCrosky & Huber, Cincinnati, O.
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Bayldon Mach. & Tool Co., Jersey City, N. J.
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Unions, Brass
Nolte Brass Co., Springfield, O.

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Vanderbeek Tool Works, Hartford, Conn.

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Valves
See Steam Fittings.

Vises, Drill
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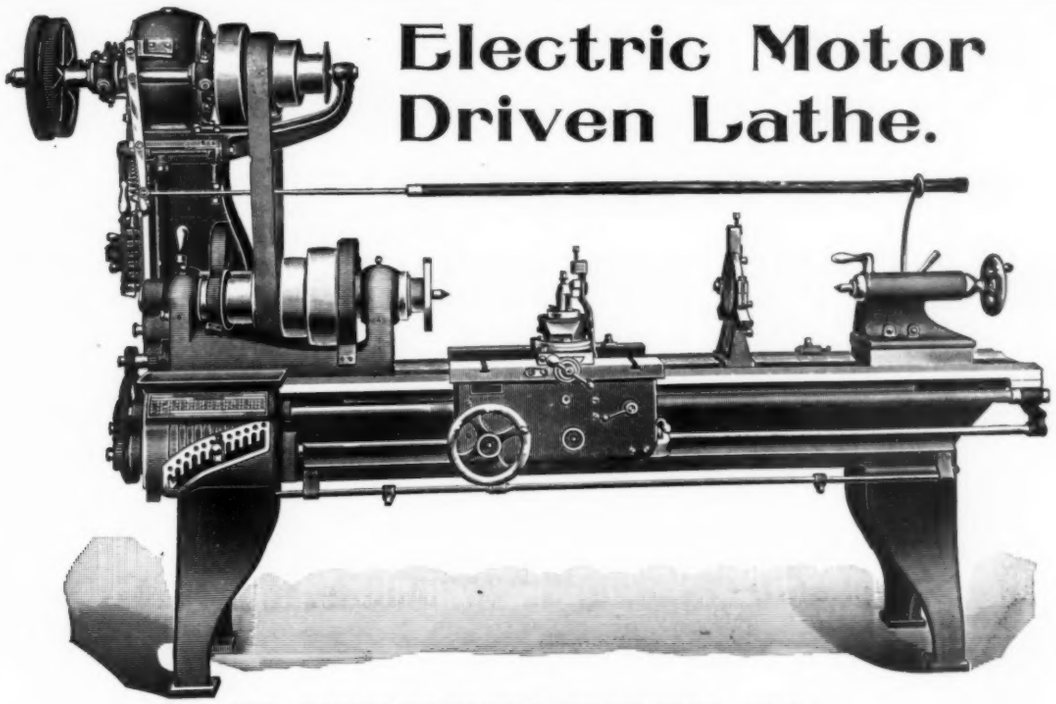

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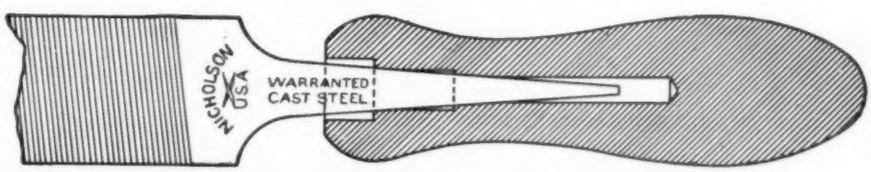

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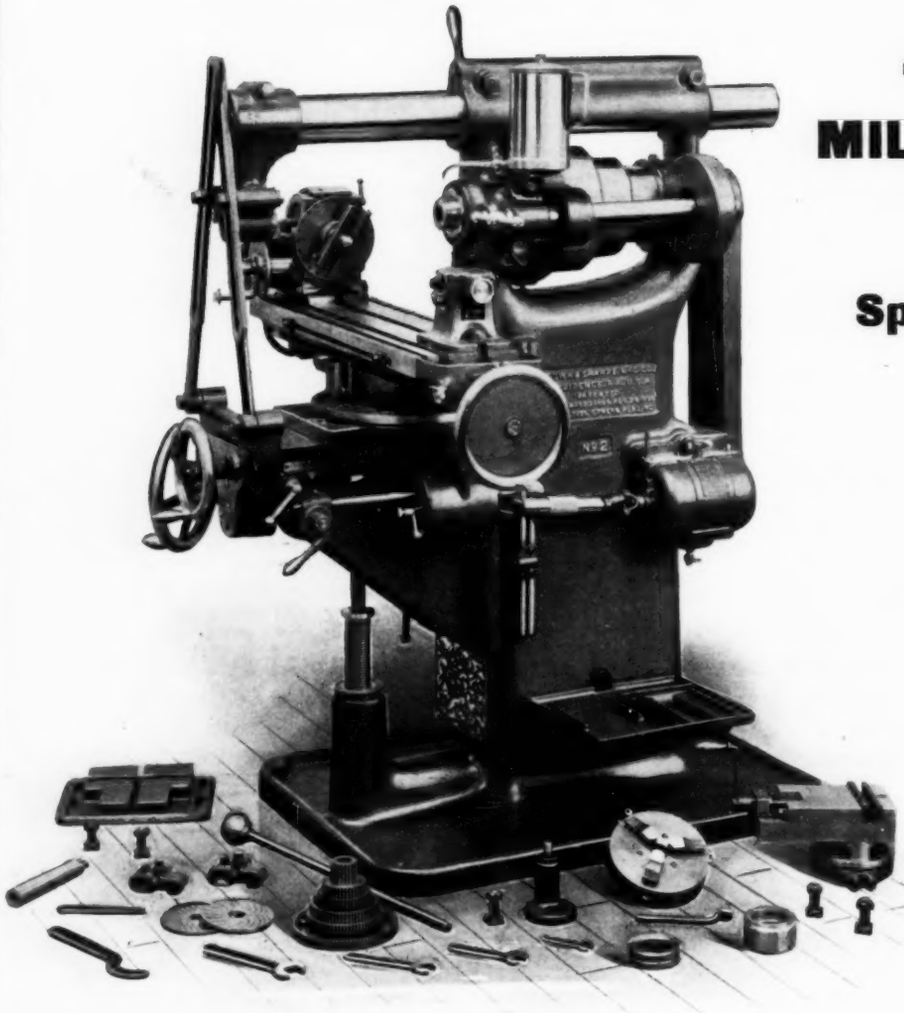

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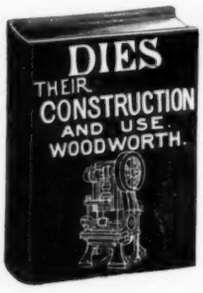

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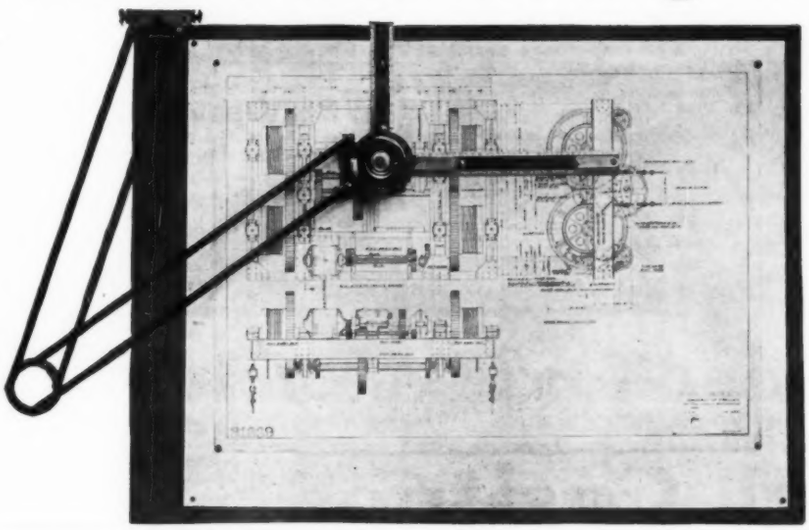

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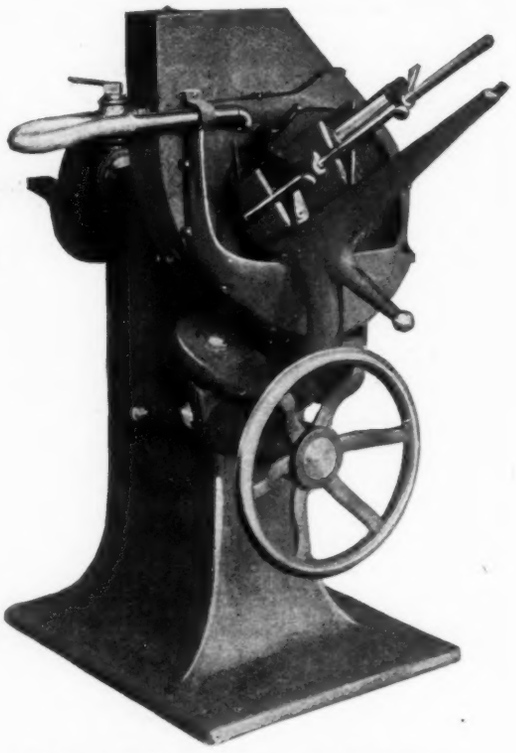

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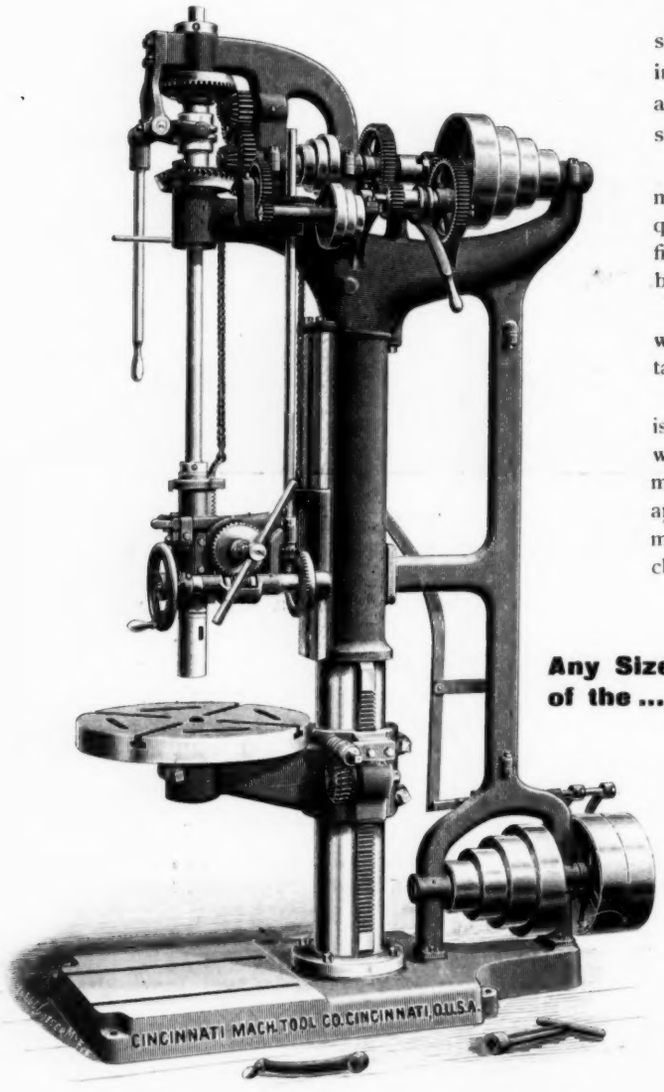

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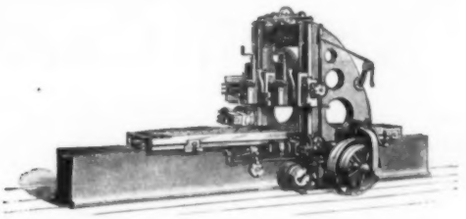

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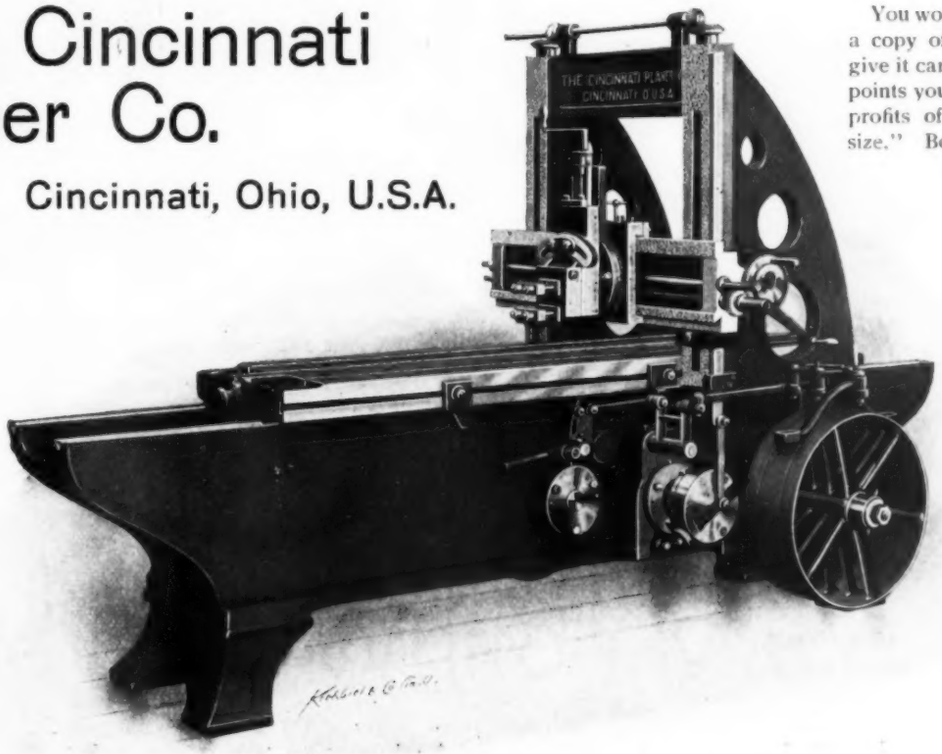

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Drill "cut off in its prime" at the shank end; screw not worn but broken.

From "Life."

We shall be pleased to have your Chuck inquiries.

Aside from this special non-slipping drill feature,

The Pratt Chuck

Is made to standard gauges and all parts are interchangeable. The jaws are ground after hardening, insuring perfect accuracy. Tool steel is used for all wearing parts. Everything is right. The price is about the same as any old chuck, so that you can well afford to have and use.

Pratt Chuck Co., Frankfort, N.Y.

Chucks For Heavy Work.

Chucks for heavy work must have design to heavy work ends; ordinary chucks are wholly inadequate to the needs of modern heavy machinery where fast feeds and heavy cuts obtain.

A group of Chucks for heavy work are here shown.

These are Whiton Chucks, designed in the Whiton way, for holding heavy work as it should be handled.

They are very strong, have a powerful grip and work is held rigidly and with all of the accuracy of smaller chucks.

Heavy work—and it is getting heavier all the time—has got to have as rapid handling as smaller work; the margins of profit are such that there is not any time to waste fussing with the chucking. The chucks have got to hold the work—have got to hold it surely and have got to be fast and convenient.

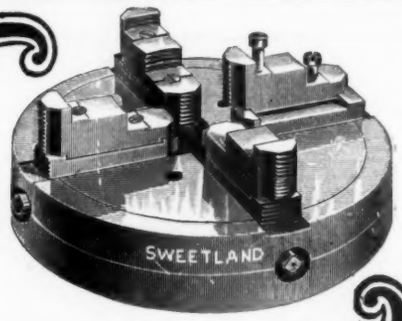
Whiton Chucks meet all of the requirements squarely and are worthy of your very critical examination.

Whiton makes all sorts of chucks, for all sorts of purposes, large, small, medium. All are good chucks, all well made, all sold at a reasonable price, all shown in catalog, which is sent on request.

The D. E. Whiton Mach. Co.

Sole European Agents—Selig, Sonnenthal & Co. **New London, Conn.** Sole German Agents—E. Sonnenthal, Jr.

Each Screw Works Independently.



Look at the large Chuck and see how easily you can throw out one jaw at a time.

Sweetland Chucks

are the only chucks that have that feature. Suppose the chuck is being used independent and you want to change to universal; just move jaws inward until end is true with line on face of chuck, then each jaw can be engaged with rack separately by sliding cam block outward. Should any jaw get out of true, you simply disconnect and reset it without disturbing the others. Sweetland Chucks represent the maximum of strength with the minimum of metal. They will neither kill your men nor pull your machine out of alignment. Catalog 6 tells all about them and describes our entire line.

The Hoggson & Pettis Mfg. Co.
New Haven, Conn., U.S.A.

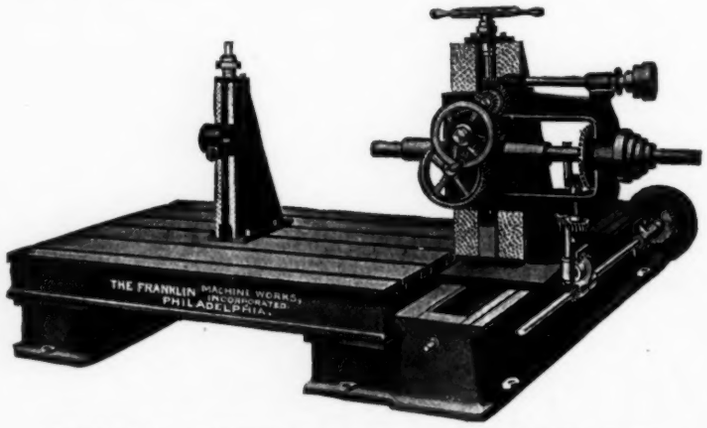
WILLIAM HENRY HANSELL,
President and General Manager.

WILLIAM STILES,
Treasurer.

The Franklin Machine Works,

INCORPORATED.

Established 1868. Philadelphia, Pa. Incorporated 1894



"Franklin" No. 1 Horizontal Floor Boring, Milling and Drilling Machine.

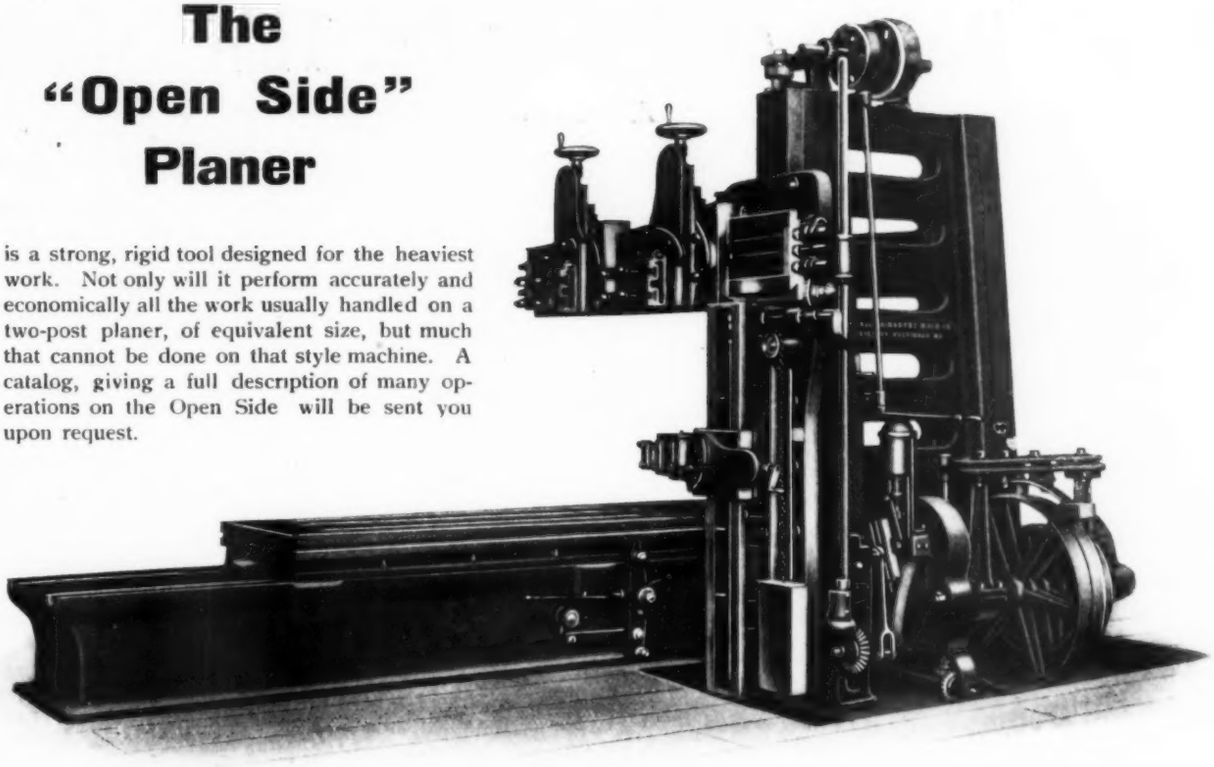
...BUILDERS OF...

Cold-Saw Cutting-Off Machines,
Plain Slab Milling Machines,
Horizontal Floor Boring,
Milling & Drilling Machines,
Rotary Planing Machines,
Slotting Machines, etc., etc.

———WRITE FOR NEW CATALOG.———

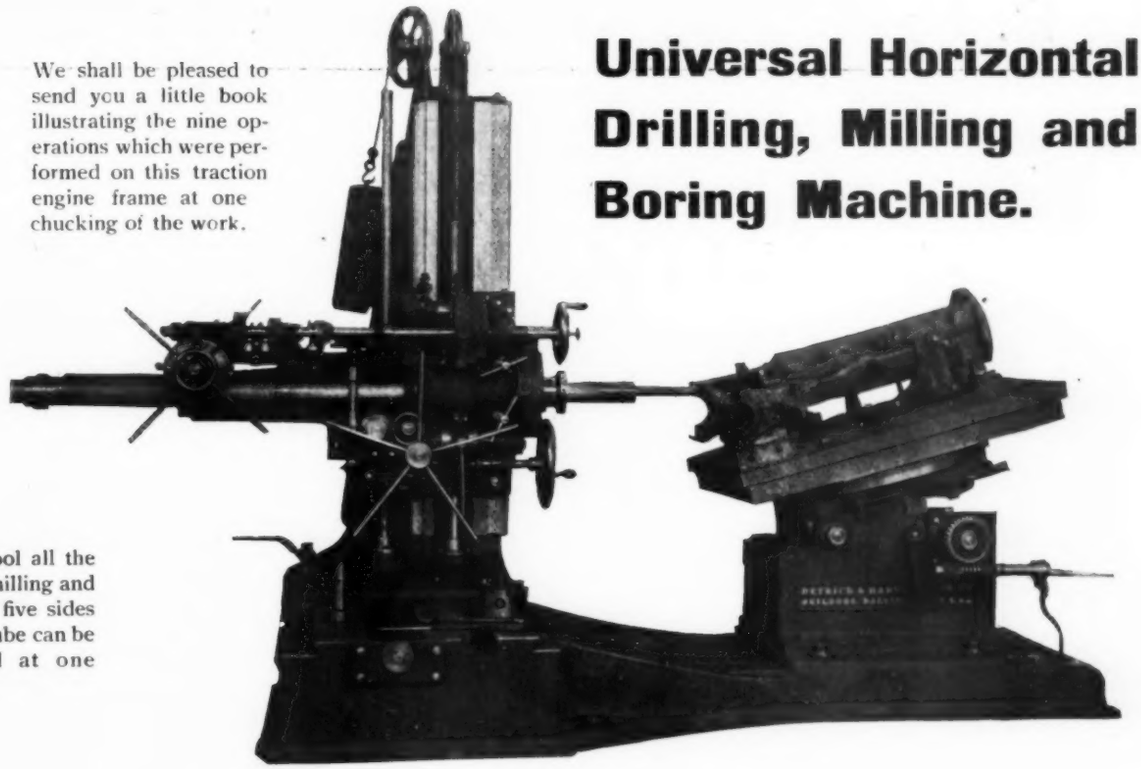
The "Open Side" Planer

is a strong, rigid tool designed for the heaviest work. Not only will it perform accurately and economically all the work usually handled on a two-post planer, of equivalent size, but much that cannot be done on that style machine. A catalog, giving a full description of many operations on the Open Side will be sent you upon request.



We shall be pleased to send you a little book illustrating the nine operations which were performed on this traction engine frame at one chucking of the work.

Universal Horizontal Drilling, Milling and Boring Machine.



On this tool all the drilling, milling and boring on five sides of a 40" cube can be completed at one setting.

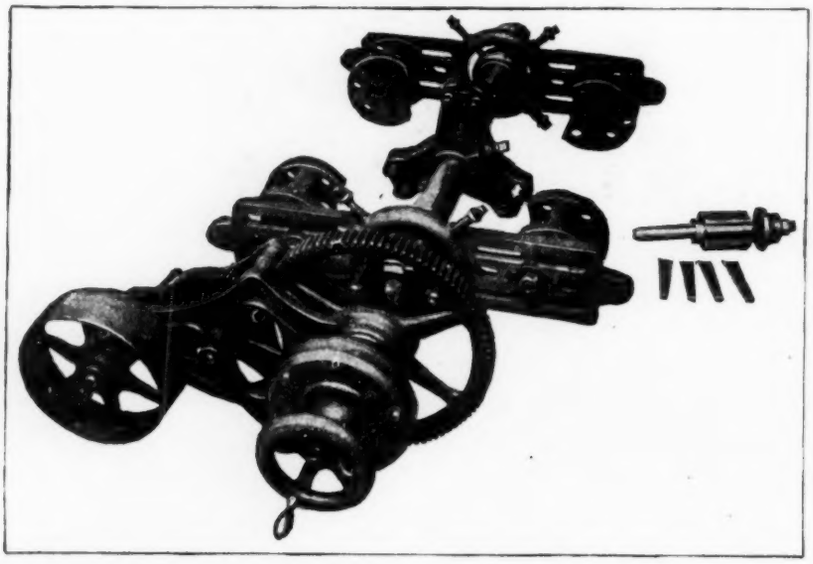
Besides these tools we make a full line of Bolt Threading and Nut Tapping Machinery and several other special tools.

The Detrick & Harvey Machine Co.,

BALTIMORE, MD., U. S. A.

L. B. FLANDER'S MACHINE WORKS.

What's the Use of Ripping Out That Cylinder For Reboring,..



cutting off steam connections, taking out holding-down bolts and putting yourself to a lot of time-wasting trouble like that? Tisn't necessary. Take our

Portable Cylinder Boring Bar

and fixtures (pictured right here at the left) and you can do the job, and do it rightly, without moving the cylinder a hair's breadth. It will work in any place where there's room enough to take the piston out of the cylinder, and with one or both cylinder heads off. These bars are powerfully back-geared, and can be driven by power or hand. Each bar has two changes of feed; the feed screw is of steel, and the feed nut is also of steel, cut in a peculiar way that insures great wear. Made in size from 2½ inches to 12 inches, to bore from 4 inches to 120 inches diameter, with strokes varying from 30 inches to 120 inches. Special sizes to order. Nothing like it for use on all sorts of Engines, Steam Hammers, Pumps, Blowing Engines, Air Compressors, Corliss Valves, etc. We'll be pleased to send you our Illustrated Catalog, which not only goes into detail on this Boring Bar but covers our Portable Valve Seat Rotary Planing Machine, Boring Bars for Lathe Work, Portable Milling Machine, and our Radius Planer Attachment. This is a line you ought to know.

H. B. Underwood & Company, 1021 Hamilton Street, PHILADELPHIA, PA.

Hear Ye! Hear Ye!

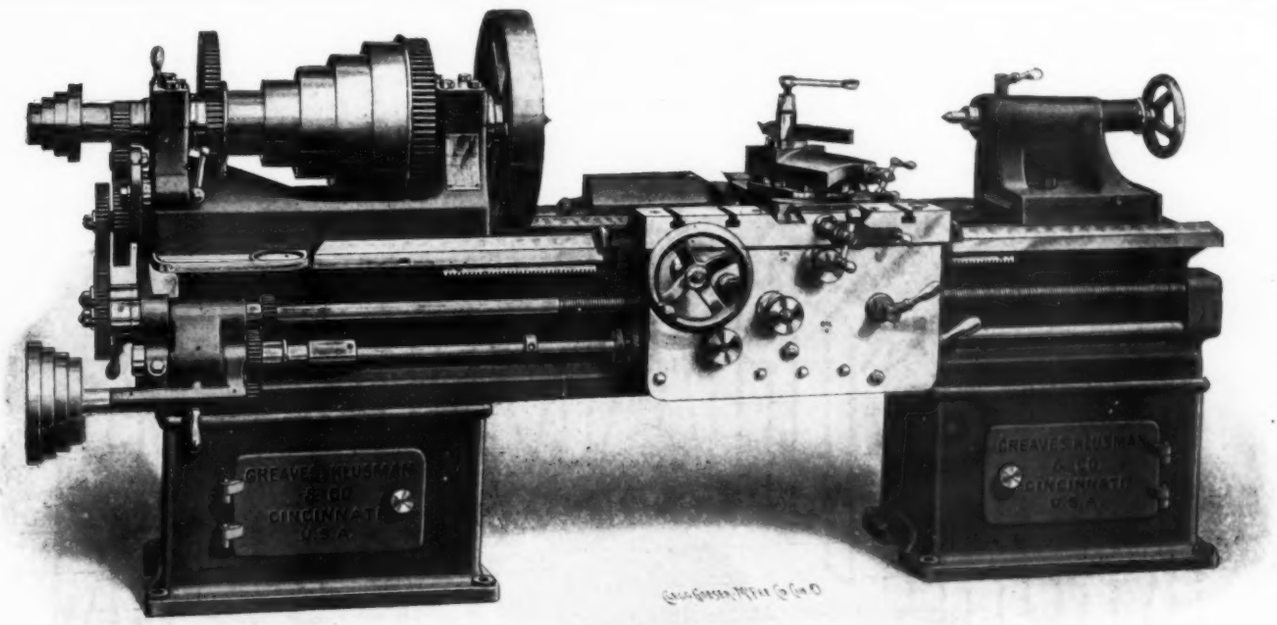
All who have leaky valves and who are intending to replace them with new ones **don't do it!**

The MORSE-DEXTER VALVE-RESEATING MACHINE

will make every valve as good as new. Valves can't wear out. Their seats, like small boys' pants, wear and wear quickly, but the "M.-D." fixes that all right, and it is the one reseater that works on mechanical principles.

This machine will pay for itself very quickly in reduced valve bills, and if you do work for your neighbors you can build an addition to your bank account. Get started by writing to us.

The Leavitt Machine Company
ORANGE, MASS.



ATHES—16 to 24 Inch.

MODERN AND UP TO DATE IN DESIGN AND CONSTRUCTION. NO FANCY CLAP-TRAPS. BUILT FROM THE GROUND UP TO MEET MODERN LATHE REQUIREMENTS. DETAILS ON REQUEST.

GREAVES, KLUSMAN & CO., CINCINNATI, O., U.S.A.

How Do You Like The Design

of our New 15″ Engine Lathe? Scrutinize it carefully and see if it doesn't strike you as being just about right in every way. When you see a lathe that has live spindles made of special steel; boxes or bearings of best phosphor bronze; tail stocks with an adjustable side movement for turning tapers; carriages of the most approved design, with long bearings on the ways, gibbed to the bed both front and back and provided with ample lubricating devices to insure the easiest running possible, you can make up your mind that that lathe is a good lathe and probably a "Sebastian." The "Sebastian" Lathe will cut either right or left hand threads from 5 to 36, and cut them as they ought to be cut, and feed either right or left as a lathe should feed. They are furnished on order with Schellenbach Screw Cutting and Feed Attachment which gives any standard thread from 4 to 50 instantly. They do lathe work right and do it quickly. That's why "Sebastian Lathes are Good Lathes" and profitable. You ought to use them. Made also in 13″ and 14″ swing and sold at a price that you can afford to pay. Our catalog is your catalog when you want it.

Sebastian Lathe Co., 117 & 119 Culvert St., Cincinnati, O.

We've built Emery Wheel Machinery for nearly forty years; such machinery has had careful design and making for this time. When conditions made it necessary to redesign and make differently, it has been done. The tools are of 1902 date, not designs forty years old.

NORTHAMPTON

Here illustrated is our 20 inch Water Tool Grinder.

This is a Tool Grinder of real worth, free from fussy contraptions, solidly built from material best suited to the service to be rendered, made by those who have spent years in this special line of work.

Arbors are of crucible steel, accurately turned, bearings carefully fitted and of such proportion to length and diameter as our long experience has demonstrated as being proper; has a water supply immediately available and in such quantities as may be needed. It is entirely above water, cannot leak or get out of order; requires no packing.

This is a tool grinder in perfect balance, free from vibration, devoid of funny attachments and sold at a right price.

GRINDERS.

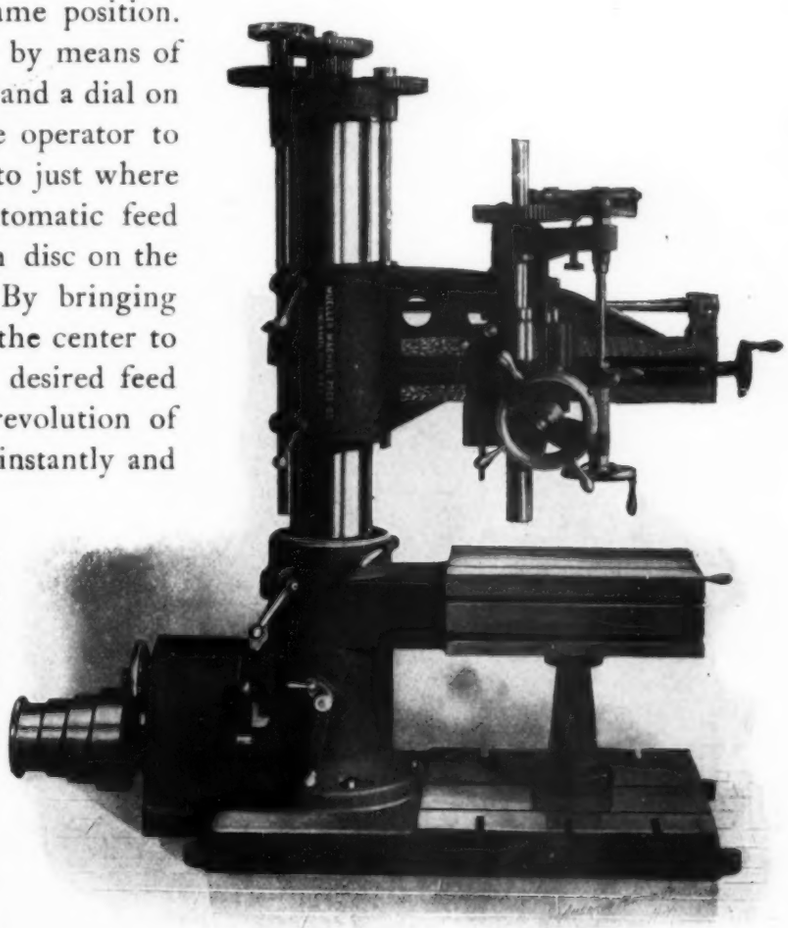
NORTHAMPTON EMERY WHEEL COMPANY,

LEEDS, MASS.

Makers of Emery Wheels, Emery Wheel Machinery and all kinds of things appertaining thereunto. These things have building and making backed by many years of experience in this special line and they represent such things reduced to extreme refinement.

This is the Mueller 62-Inch Radial Drill. It is a Drill combining more valuable drill features of real worth than any other made, which guarantees more accurate work, more rapidly handled, resulting in faster dividends.

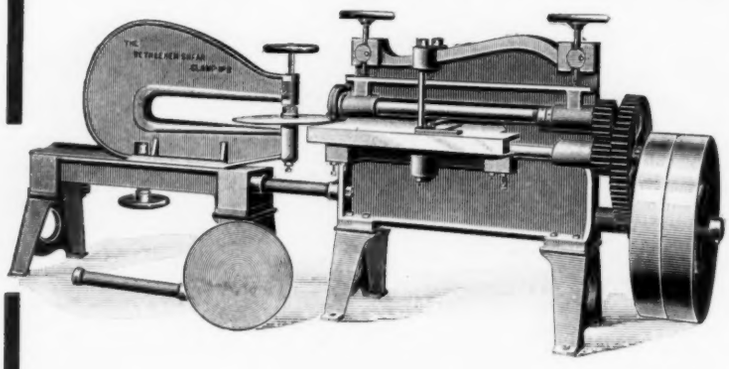
Every last thing that can serve a useful drill purpose has its place with this drill, but no traps, no nonsense, nothing trivial or foolish. It is strong and symmetrical, has every convenience for easy handling and all of them simple. A little crank at the base of column controls sixteen spindle speeds without stopping or fussing with the countershaft. Spindle is started, stopped or reversed, and arm is raised or lowered by little lever in loose ring encircling column just above swinging platen. Automatic stop can be set to release the spindle feed at any point, and a safety stop prevents the spindle from feeding beyond its stroke. When the spindle isn't busy, the lower driving shaft is the only thing that moves, not wasting power or wearing a good machine out doing nothing. A graduated ring on the lower part of column, revolving with the arm, allows the spindle to be swung out of the way while placing new work into fixed jigs, and which can be brought back to the same position. The saddle is traversed by means of a double pitched screw, and a dial on its outer end enables the operator to bring the spindle back to just where it was before. The automatic feed is driven thro' a friction disc on the spindle pinion shaft. By bringing the driven wheel from the center to outer edge of disc, any desired feed from .000 to .023 per revolution of spindle can be obtained instantly and while drill is at work.



These few features will serve to point the excellence of others of which there are many. We are pleased to have your inquiries and to send you full details on request.

Mueller Machine Tool Co.,
Cincinnati, Ohio, U.S.A.

You can't forget



Bethlehem

The very name seems to suggest good things —and if you want a **ROTARY SHEAR** that will cut circular plates from ½" iron or steel, 1-16" from the edge, get a

Bethlehem Shear.

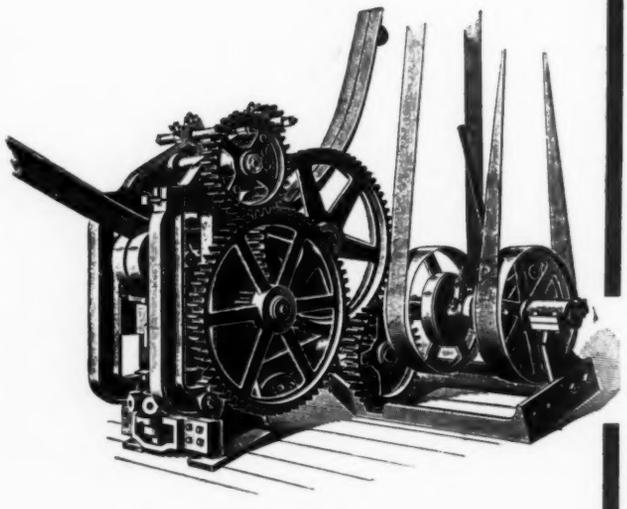
It will slit plates 7-16 or less in thickness 1" to 31" from the edge and will do all cutting or shearing more rapidly and accurately than any other shear made.

Bethlehem Benders

Will bend angle iron, tee iron or pipe in circles or curves without twisting or warping. If you want a bending machine, something better than other makes, a machine that will economize in time for you on every piece of work it handles,

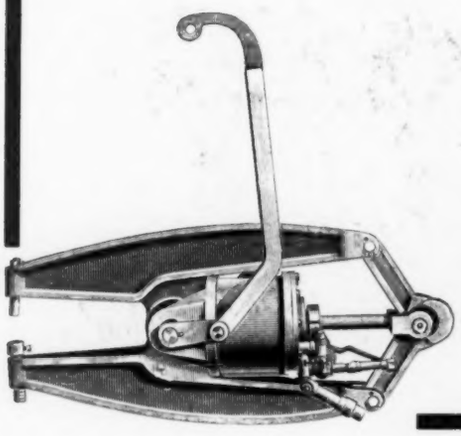
GET A

Bethlehem Bender.



And if your work requires Riveting,

Our Portable Riveter

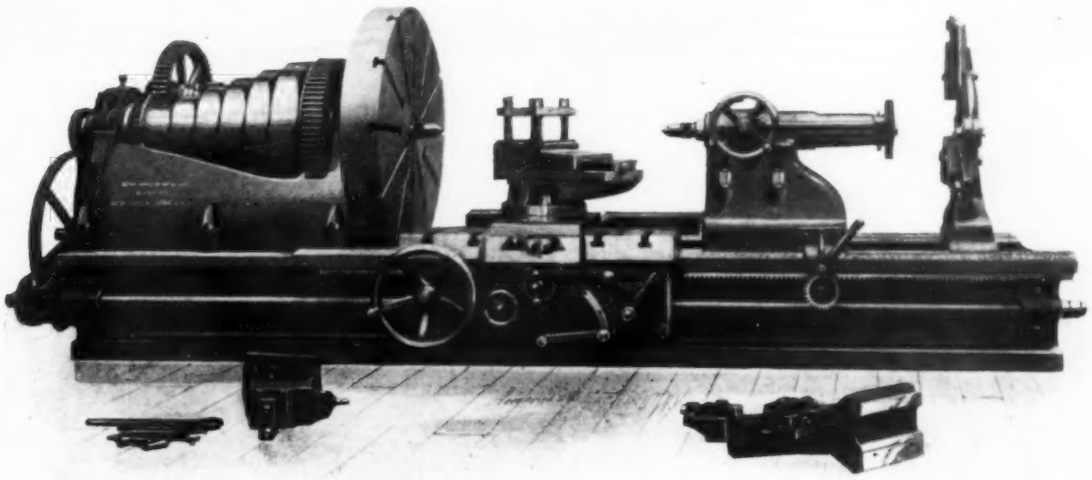


is your machine. Built to stand hard usage—to wear and work—every part is carefully constructed with this end in view. It's a tool of tools, nicely balanced. It will work in any position—will drive any ordinary sized rivet and drive it well. Suitable for shop or bridge work. Uses little air and will drive 3000 ¾" rivets in ten hours.

Read this again and remember to send at once for Catalog of specialties made by

The Bethlehem Foundry & Machine Co.

So. Bethlehem, Pa., U.S.A.



Machine Tools of a Known Quality

"New Haven" Machine Tools have ever been known as tools of rare merit, as tools possessing many conveniences, and tools that have renown for the handling of work rapidly and accurately.

New Haven excellence is not of mushroom growth, it is the result of nearly sixty years of untiring effort along progressive lines. They have always been, and always will be, up to date; they have had new design whenever new conditions have had to be met.

They are no old time models adapted to new needs. When new needs have had to be met, new designs have been made to meet them. They have been new designs from the ground up and our many years of experience have pointed the direct and positive means to new ends without any cutting and trying or any experiments.

There are many things you can be sure of when buying New Haven Tools. You are sure of getting tools that you can depend upon; that they can be used day after day and year after year, always with satisfaction; they will handle your work rapidly, it will be accurately handled and easily handled; they are extremely convenient; they are backed by a New Haven guarantee that they are right and they are reasonably sold.

These tools are: Lathes, Planers, Drills, Slotters, Etc. They are made in many sizes, from large to small; they cover all machine shop work thoro'ly.

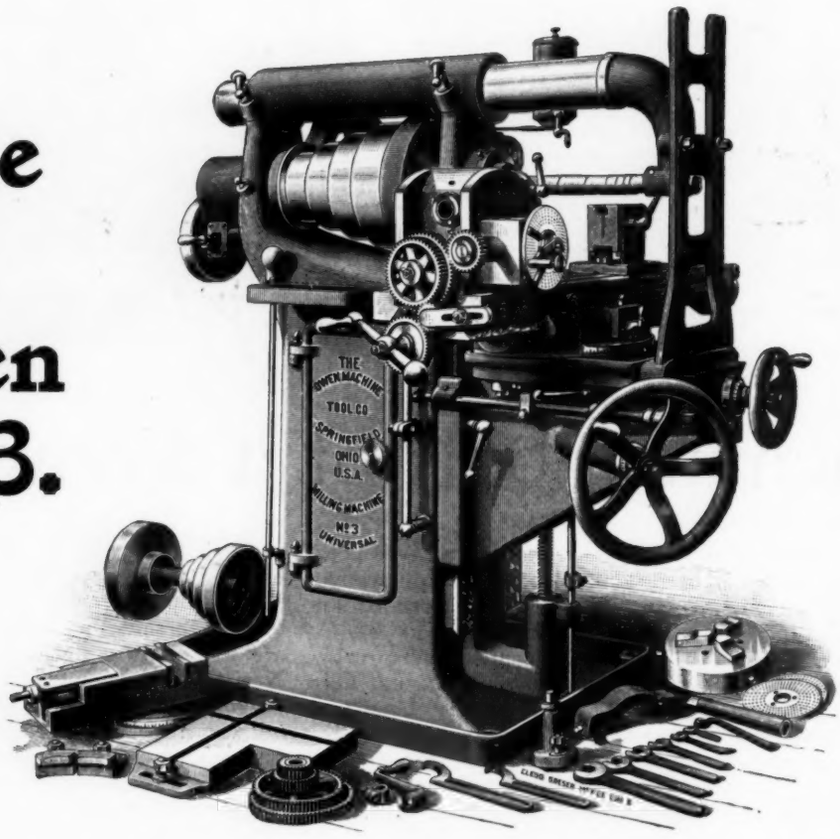
We invite your machine tool inquiries and are pleased to send literature.

New Haven Mfg. Co.,

Makers of
Lathes, Planers, Drills, Slotters, Etc.

New Haven, Conn., U.S.A.

Just Take The Owen No. 3.



The Owen No. 3 Milling Machine represents milling machine design and usefulness reduced to the finest dots. You can do things on the Owen that the others can't touch, and the Owen does all of the things the others can do, only it does them better. Work gets done when you put it on the Owen, therefore the Owen is a good milling machine to have on the floor of your shop.

Among other features of the Owen No. 3, are: a crucible steel spindle with an $\frac{11}{16}$" hole thro' it; it runs in phosphor bronze boxes; has means for taking up any possible wear in spindle or boxes at once; back gears give eight changes of speed and there are sixteen changes of feed without changing a gear or pulley; these feeds vary from .004" to .120" for one revolution of the spindle; feed of table is automatic in either direction for 29" and can be engaged by simple movement of lever in front of swivel, and disengaged by an auxiliary lever (furnished only when "in and out" and "up and down" feeds are put on machine) releasing any feed instantly; swivel can be clamped at any angle up to 45°; adjustable dials, graduated to read in thousandths, indicate longitudinal and vertical movements of the table. Other things in the book, free on request.

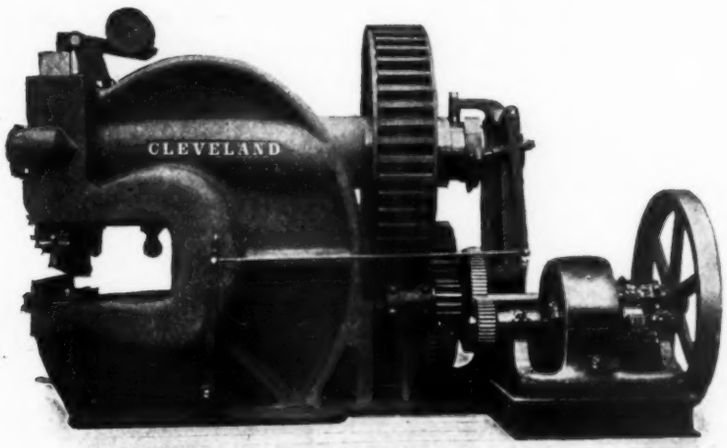
Naturally we think this is the best milling machine of its size built. In this we are borne out by the testimony of users, and if users don't know, who does? Anyway we ask you to investigate thoro'ly and invite your inquiries.

The Owen Mach. Tool Co., Springfield, O.

AGENTS:

DOMESTIC—Chandler & Farquhar, 36 Federal St., Boston, Mass. Prentiss Tool and Supply Co., Pittsburgh, Pa. The American Tool Works Co., 6th and Eggleson Ave., Cincinnati, Ohio. C. C. Wormer Machinery Co., 57 Woodbridge St., West, Detroit, Mich. W. R. Colcord Machinery Co., 423 and 425 N. Second St., St. Louis, Mo. The Mine & Smelter Supply Co., 17th and Blake Sts., Denver, Col.

FOREIGN—Alfred Herbert, Coventry, England. de Fries & Co., Dusseldorf, Germany, Austria, Hungary, Russia, Switzerland and Italy. Hermann Hirsch, Stockholm, Sweden.



All we ask is an investigation of Cleveland Iron Working Tools when you are in the market.

Twenty years experience in building Punches, Sheare, Rolls Metal Saws, Rotary Planers etc, enables us to say

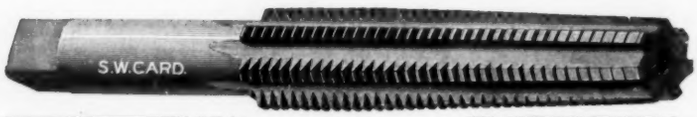
Our name guarantees quality.

It will be worth your while to ask for our #5 Catalogue a book of machinery information.

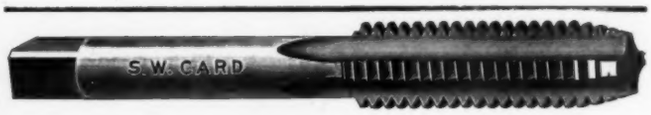
The Cleveland Punch + Shear Works Co.

Cleveland. U.S.A. Pittsburg.

Some Few Taps



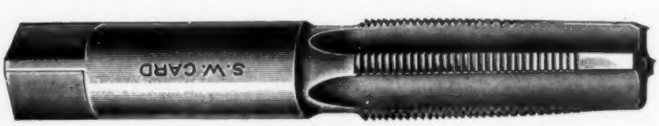
made by Card, just to remind you that you can never hope to be truly happy until you use them in your shop on your work. Card has the business sense to realize that taps and the like have got to be close to perfection in these present days; so Card, first of all, makes them as close to perfection as rightly directed brains and money will bring them; after that comes the realization that price is often attractive.

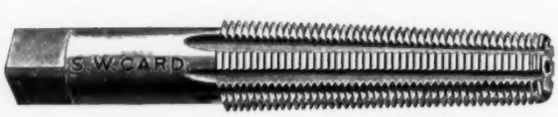


Card makes the price attractive, so there you are: the best taps and the like that can be made, sold at a price which removes all excuse for not using them.

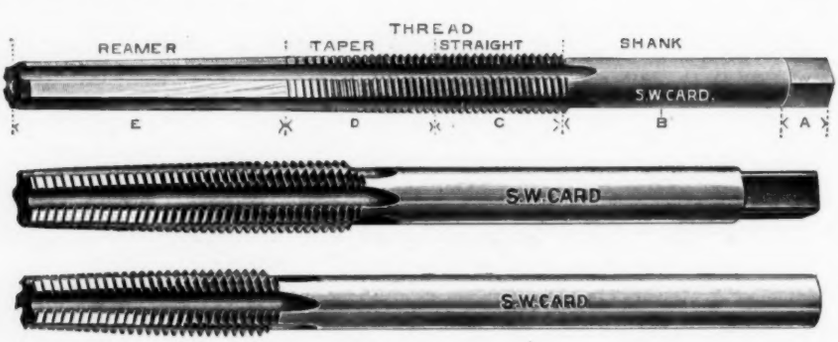
Card Taps are no new institution, no experiment to be proven by the user at his own cost. They have had their hard, uphill introduction. To those who use things made by Card there is no appeal; such people know Card products as "good goods" and that they are worthy of a place in every shop on earth making pretense to progressiveness.

They come thro' a shop where every man is a specialist and every man is an enthusiast, jealous of the Card reputation. No work gets out doors that's not right; there are no seconds, no job lots; everything is to the highest possible standard, and nothing gets out to come back as a failure. You who use Taps and kindred things can well afford to use Card's, because they are reliable, are properly made, are always right and always alike, the cost is as it should be—within reason. These things come in an endless variety; they have design for every possible tap purpose.





Card invites your inquiries, and orders, large or small; assures you of prompt attention.



S. W. Card Mfg. Co., Mansfield, Mass., U.S.A.

Tap and Die Makers to Progressive People Everywhere.

Chas. Churchill & Co., London, Birmingham, Manchester and Glasgow.

A STUMP SPEECH

Style "P" Wet Grinder.

Capacity: ¼ to 2½-in. Drills.

ABOUT DRILL GRINDERS;

About Good Drill Grinders; About the Very Best Drill Grinders and the ONLY Drill Grinders that DO NOT have the Calipering Device which requires many adjustments.

THE NEW YANKEE GRINDER

is so simple anyone can operate it.

DID YOU EVER stop to consider that a drill is a tool used in a shop more than any other and that no tool is more abused than a drill? **WELL, NOW THEN,** here is a machine requiring only **one** adjustment. Will grind drills **right;** will grind at any clearance desired and suited for the work to be done; therefore, much better and faster work.

A big percentage of wear and breakage saved and a larger percentage of time saved in grinding. We leave it to you if there is any machine tool that will pay for itself as soon as one of these machines.

DROP US A POSTAL AND WE WILL SAY MORE.

Wilmarth & Morman Co.

157 CANAL STREET,

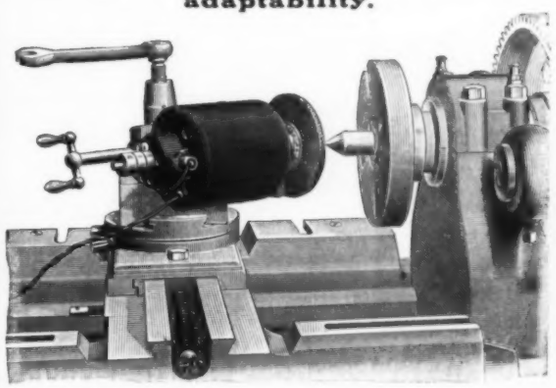
GRAND RAPIDS, MICH.

...Not a One Job Tool...

The

"Hisey" Electrical Grinder

will surprise you at its adaptability.



4¼-in. x 7½-in., 16 lbs., ¼ H.P.

We above illustrate the "Hisey" grinding a center. This is just one o the many jobs it will do. Just as handy for grinding **Cutters, Reamers, Dies, Piston-Rods,** etc. Also for **internal** and **surface** grinding. Set in any tool-post. Connect with ordinary lamp socket and it's ready. Direct current. Made in three sizes of ¼, ½, 1 H.P. Will send you one on trial, if you'll permit us. Our booklet A illustrates fully. Write to-day.

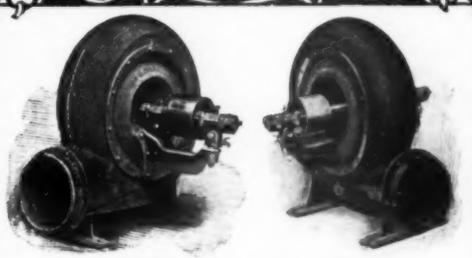
Built in their entirety by

The Hisey-Wolf Machine Co.,

Cincinnati, Ohio, U.S.A.

FOREIGN AGENTS—Chas. Churchill & Co., London, Birmingham, Manchester, Glasgow. Schuchardt & Schutte, Berlin, Vienna, Brussels, St. Petersburg, Stockholm.

FAB



A Word to the Wise

Space forbids an exhaustive treatise on the merits of

"A B C" Volume Blowers

We can only enumerate a few of their sterling qualities and leave further investigation to you, through the medium of our catalog and personal correspondence. We furnish Blowers for every conceivable application, and guarantee in them the greatest efficiency at the least expense for power. Send for description and prices.

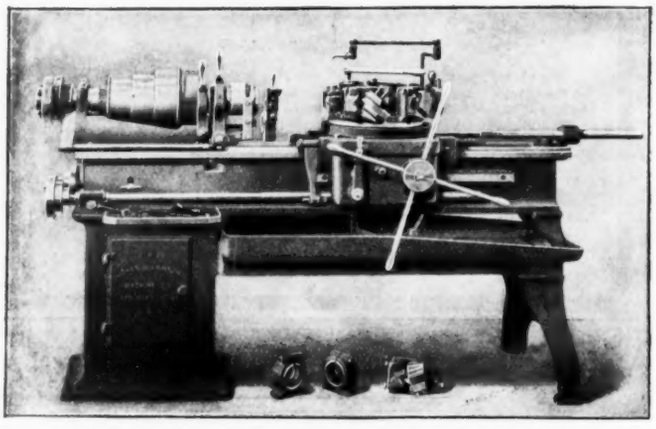
American Blower Co.,

Detroit, Mich.

New York,
Chicago,
London.

THE STORY OF THE

FLAT TURRET LATHE



TOLD IN A DOZEN OR SO CHAPTERS.

CHAPTER TWENTY.

Being the Exposition Of A String-less Proposition.

This is the Jones and Lamson "Flat Turret" Lathe.

The "Flat Turret" points a straight way to an increased profit in your shop, it affords a faster production and one that is unqualifiedly accurate.

It is for the handling of duplicate lathe work—in few or many pieces—coming within 2-in. diam. by 24-in. to 36-in. in length, from the rough or polished bar, in any shape or section—round, square, flat, hexagon, octagon, etc.—and in any metal, altho' it has special value on iron and steel.

On this work—down to as few as six to ten pieces—it will effect a saving, in one way and another, of from 50% to 80%, the average standing at 70%.

You are not asked to take our bald statement of saving as being so because we say so; we stand ready to "make good" and to allow you to do the judging on your own premises by your own workmen and on your own work.

The exposition of the proposition without a string has its beginning at this point.

If you'll send us a sample of the work you have to do, or something quite similar, we'll put it thro' on the "Flat Turret" and we'll make a hard, positive guarantee—drawn to cover the special case—as to what can be saved by handling the same work on the "Flat Turret."

This guarantee will be without strings, 'twill be no cunningly put together agreement of ifs, buts or ands, it will guarantee the "Flat Turret" to do certain things without quibble or excuse.

The guarantee is based on what the "Flat Turret" will do in your shop, on your work, by your workmen, and under your shop conditions, and not on what we can do in our shop.

We'll put the "Flat Turret" into your shop and let you do the work yourself. We'll afford you every facility for knowing about it before you handle any cash towards its purchase.

If it fails in any particular in maintaining the terms of the guarantee, hold it subject to our order for shipment.

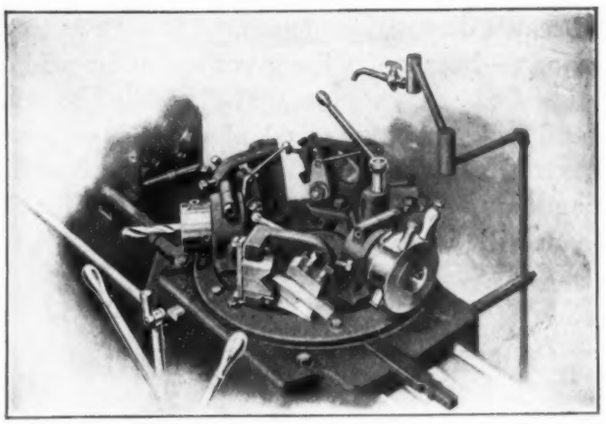
On the other hand, if it meets its requirements fully and satisfactorily down to the smallest dot, we hope for a check in payment for it.

In accepting this proposition you are not becoming liable to anything at all—except the trouble of proving the machine wrong. If you can there'll be no waiting, no excuses, no imploring of you to buy.

You buy on your own unbiased judgment or not at all.

The whole thing comes into your hands for trial and judgment, backed by a guarantee that the machine will accomplish certain ends. If we fall down it's at our own expense.

We hope to hear from you.



This is the Turret from which the machine gets its name.

FLAT TURRET LATHE

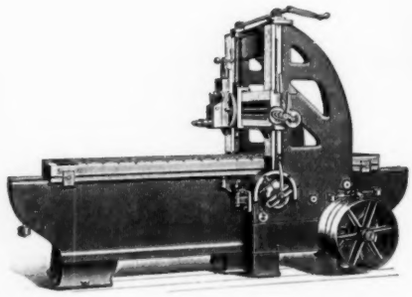
MANUFACTURED SOLELY BY

JONES & LAMSON MACHINE COMPANY,

SPRINGFIELD, VERMONT.

ENGLISH OFFICES:

Jones & Lamson Machine Co., Exchange Buildings, Stephenson's Place, Birmingham, England.
Germany, Holland, Belgium, Switzerland, Austria-Hungary and Italy: M. Koyemann, Charlottenstrasse 112, Dusseldorf, Germany.
France and Spain: Ph. Bonvillain, 6, Rue Blanche, 6. Paris, France.



After a Half Century

WHITCOMB PLANERS

Still maintain the lead among all makes of Planing Machines. Reason No. 1—Because of the high class of workmanship employed. No. 2—Because disposition of material is such as to give perfect rigidity and strength. No. 3—Because of the great attention paid to details.

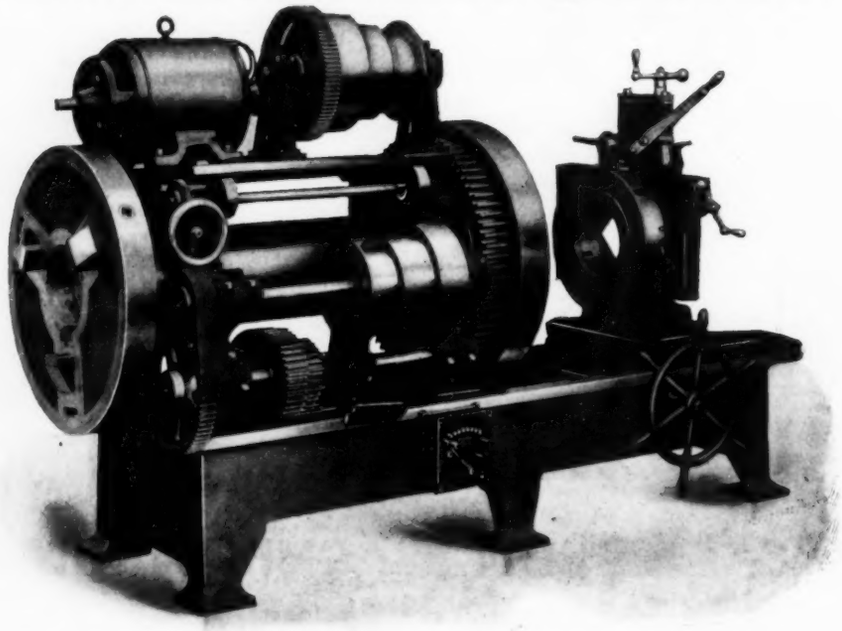
Beds are heavy and stiff, tracks are wide and fitted by scraping, gears and racks are wide faced, shafting is of large diameter steel, bearings are of extra length, headwork is strong and well proportioned to give range and handiness. Many other reasons, all of which we will be glad to give you if you will write.

Whitcomb Mfg. Company,
Worcester, Mass., U.S.A.

CHICAGO AGENT, McDowell, Stocker & Co., 61 So. Canal St.

Motor Driven Threading Machines

"B. & K. TOOLS ARE BETTER."



"B. & K. TOOLS ARE BETTER."

AGENTS:
Hill, Clarke & Co., Boston, New York and Chicago. Manning, Maxwell & Moore, Cleveland and Pittsburg. J. W. Cregar Agency, Philadelphia. Harron, Rickard & McCone, San Francisco.

Bignall & Keeler Mfg. Co.,
Edwardsville, Ill.

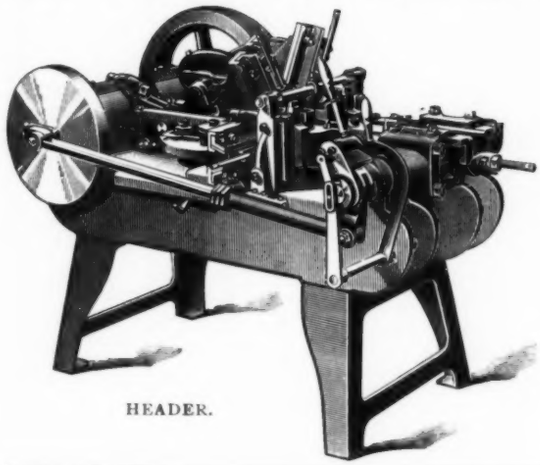
Burdict Bolt Machinery

Automatic Threaders, Pointers, Nutters and Tappers,

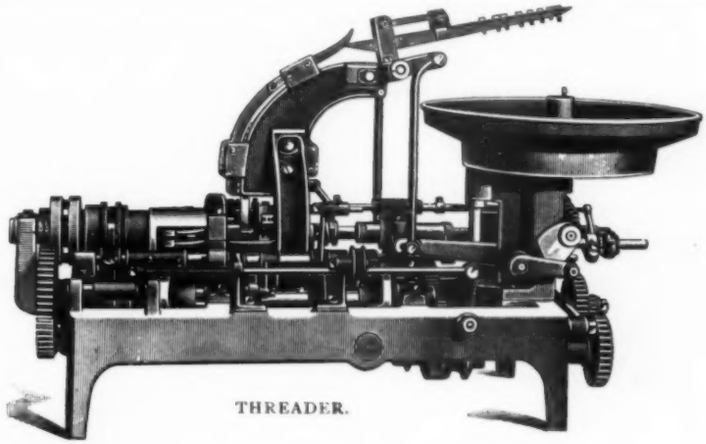
Also Bolt Headers for Square and Hexagon Heads.

A full line of Burdict Bolt Machinery including the new No. 1 and No. 2

HOT PRESSED NUT MACHINES.



HEADER.



THREADER.

Write to

Howard Iron Works,

Buffalo, N.Y.

...ALSO MANUFACTURERS OF...

ELEVATORS

High-Grade Passenger and Freight Elevators a Specialty.

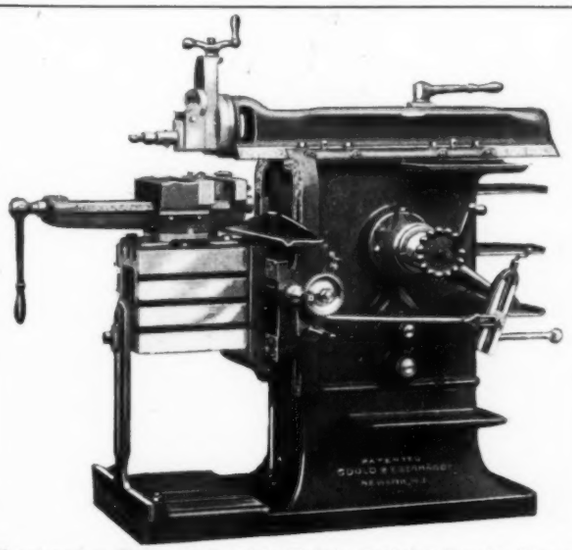
We are among the oldest elevator manufacturers in the country and are giving special attention to this branch of business. If you are looking for first-class work it will pay you to correspond with us.

...We can ship Belted Worm Gear Machines from Stock...

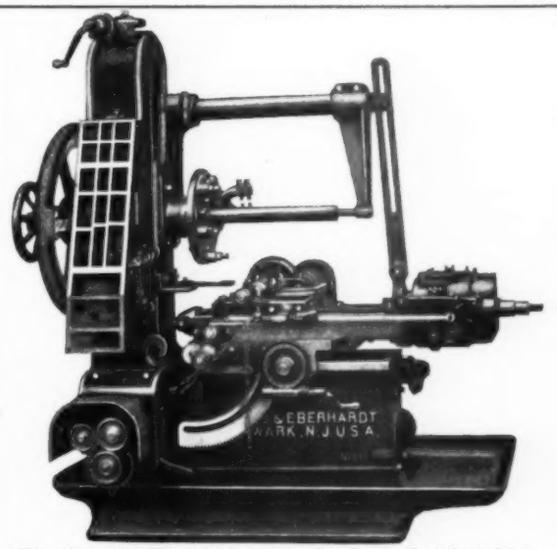
Gould & Eberhardt

NEWARK, N. J.

Designers and Builders of High Class Machine Tools.



Eberhardts' Patent "Double Triple Quick" Stroke Shapers with Patented Extension Base and Support to Table.



Eberhardts' Patent Automatic Gear Cutting Machines. 18 styles and sizes—for all purposes.

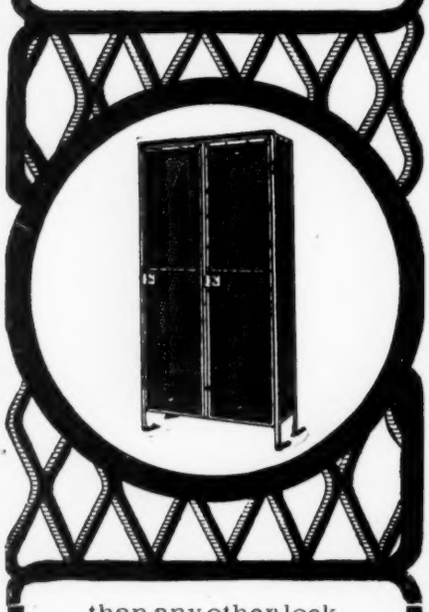
We also make Upright Drill Presses, with automatic tapping attachments. . . . .

A little higher in price, perhaps, than some others, but there's a good reason for it—the QUALITY will be remembered long after the price is forgotten. . . .

If interested send for our catalog.

Expanded Metal LOCKERS

Are the kind of lockers needed in your shop; they will last longer, prove safer



than any other locker made.

The material used in building Expanded Metal Lockers is sheet steel. This is cut and opened into 3-4 inch diamond shape openings without being jointed or interwoven.

Meshes, therefore, cannot be forced apart like woven wire but will stand any human pressure brought to bear.

They admit plenty of light and air, are therefore sanitary and always dry.

Our booklet "About Lockers," tells how they will pay for themselves.

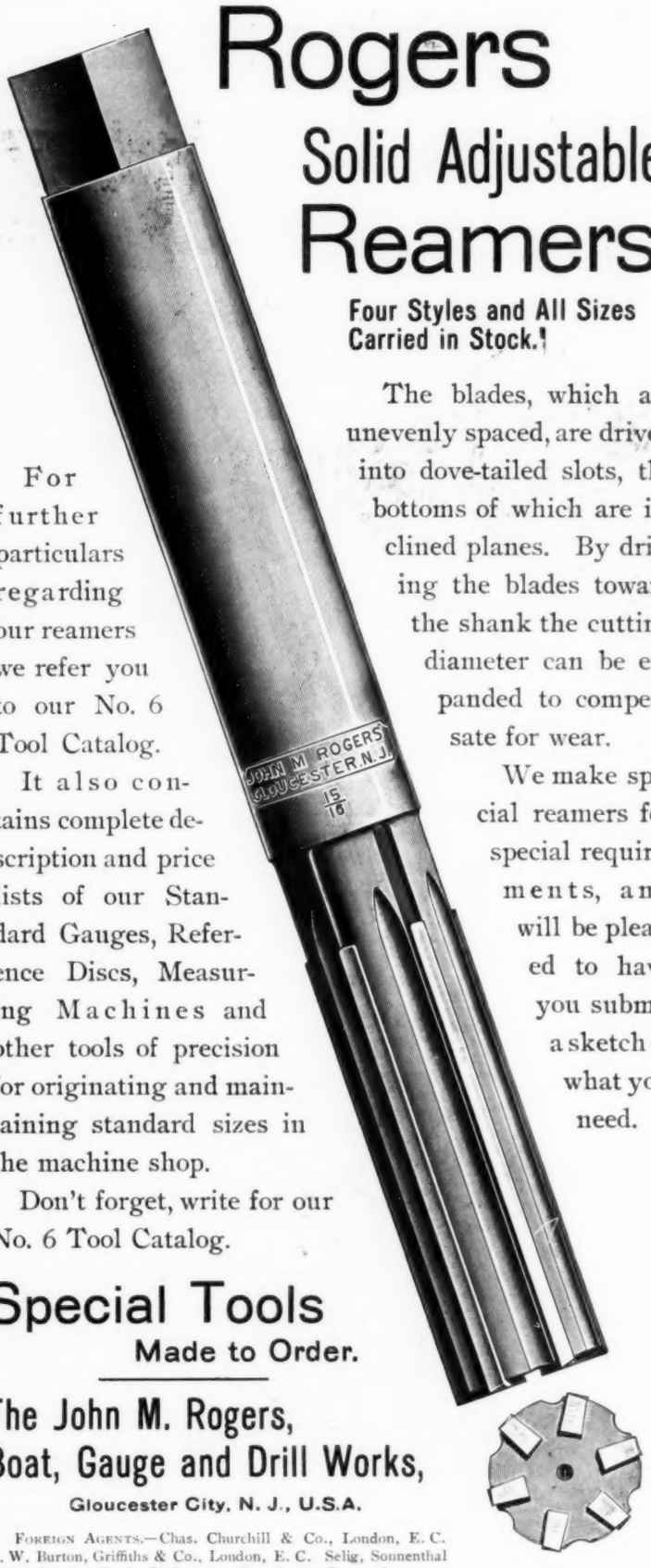
Merritt & Co.

1025 Ridge Ave.,

PHILADELPHIA.

Rogers Solid Adjustable Reamers.

Four Styles and All Sizes Carried in Stock.



The blades, which are unevenly spaced, are driven into dove-tailed slots, the bottoms of which are inclined planes. By driving the blades toward the shank the cutting diameter can be expanded to compensate for wear.

We make special reamers for special requirements, and will be pleased to have you submit a sketch of what you need.

For further particulars regarding our reamers we refer you to our No. 6 Tool Catalog.

It also contains complete description and price lists of our Standard Gauges, Reference Discs, Measuring Machines and other tools of precision for originating and maintaining standard sizes in the machine shop.

Don't forget, write for our No. 6 Tool Catalog.

Special Tools
Made to Order.

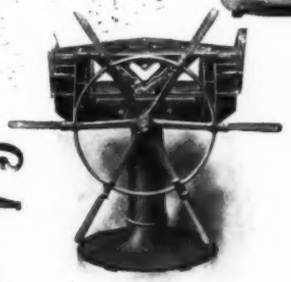
The John M. Rogers, Boat, Gauge and Drill Works,

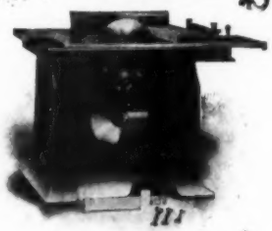
Gloucester City, N. J., U.S.A.

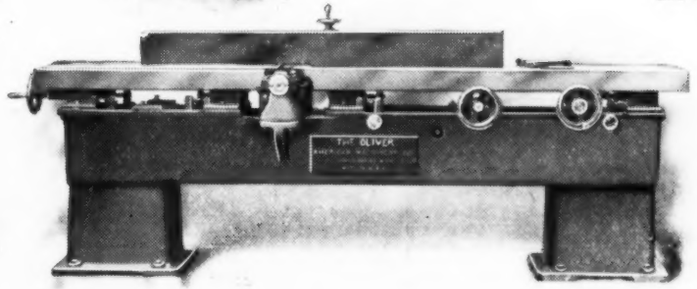
FOREIGN AGENTS.—Chas. Churchill & Co., London, E. C. C. W. Burton, Griffiths & Co., London, E. C. Selig, Sonnenthal & Co., London, E. C. V. Lowener Copenhagen, Denmark.

The LESS you use these and — the MORE you use these

the more time you'll save in your PATTERN SHOP







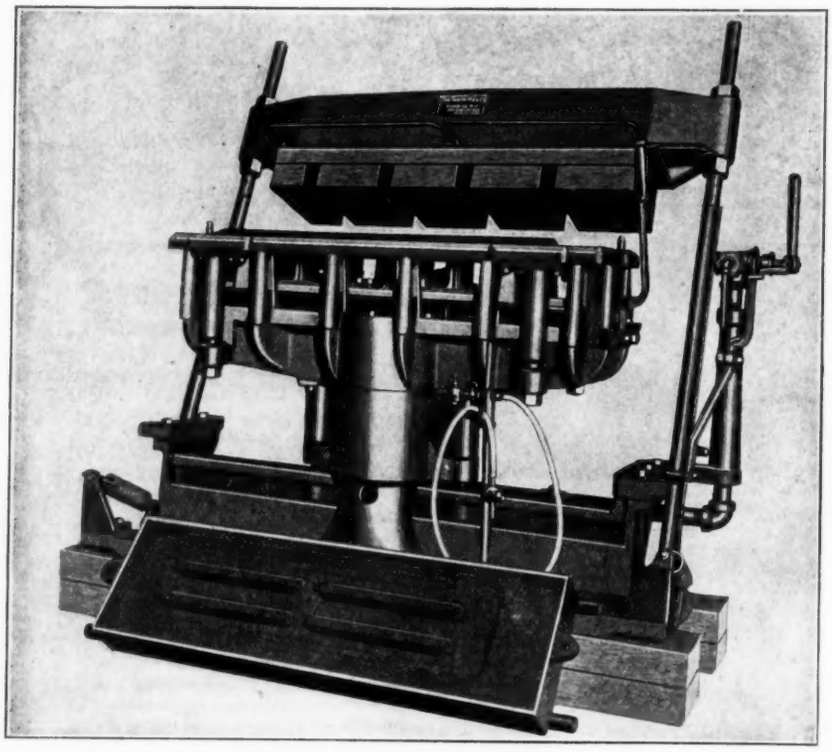
Of course, you cannot get along without the small tools. But isn't it a foolish waste of time and good money to take unlimited time with hand tools when a few well-directed motions upon one of the suitable tools which compose the Oliver Pattern Shop Equipment would do the same work in a fraction of the time and do it just as well, or a little better? Mind you, the Oliver Wood Trimmer produces a surface so smooth that fine sandpaper would scratch it. The Oliver Hand Jointer will plane a draft on every straight piece of lumber that passes through the patternmaker's hands because the rear table will tilt. Just think about that feature. The Oliver Saw Bench will save all the time that goes to waste in computing compound angles. The table may be set to any bevel as well as the gauges. Each independent degree is graduated. Your best workman with his best small tools cannot produce better work, no matter how much time he takes. With a small Oliver Trimmer on the bench of each workman, a large one for the general use of every five or six of them, an Oliver Saw Bench conveniently placed, and a Hand Jointer of the most improved style, your pattern shop costs will take on an entirely different, and an infinitely more pleasing complexion. If you own, or are responsible for results in, a pattern shop, you will surely be interested in our free literature on pattern shop economy.

American Machinery Co.,
Pattern Shop Equipments,
20-22 Mill St., Grand Rapids, Mich.

Branch Offices: 47 Grosvenor Chambers, Deansgate, Manchester, Eng. Also Fenwick Freres & Co., Agents, Paris, Brussels, Milan, Zurich, and La Chaux de Fonds, Barcelona.

American Machinist

IT'S A TABOR
Vibrator
Molding Machine



That is needed in your Foundry to help out the profit end.

No need to balk over it. You've simply got to do high-grade work and plenty of it if you wish to enter into competition or last in business.

No time like to-day for improving opportunities.

If you can visit our plant and see our machines, in operation, well and good; if you cannot visit us, write us, we will tell you all about what the Tabor Machines have done and will do. A good suggestion: "Pays to look around before buying."

The Tabor Manufacturing Co.

18th and Hamilton Streets, Philadelphia.

MACHINERY TRUST, Ltd., 189 Fleet St., E. C., London, Eng. DOMINION RADIATOR CO., Ltd., Toronto, Ont., Can.
SCHUCHARDT & SCHUTTE, Berlin, Brussels, Vienna, St. Petersburg.

Modern Profilers

The Beltless Kind.

Driven by a Drive that Drives.

Advantages.

Great saving of floor space.

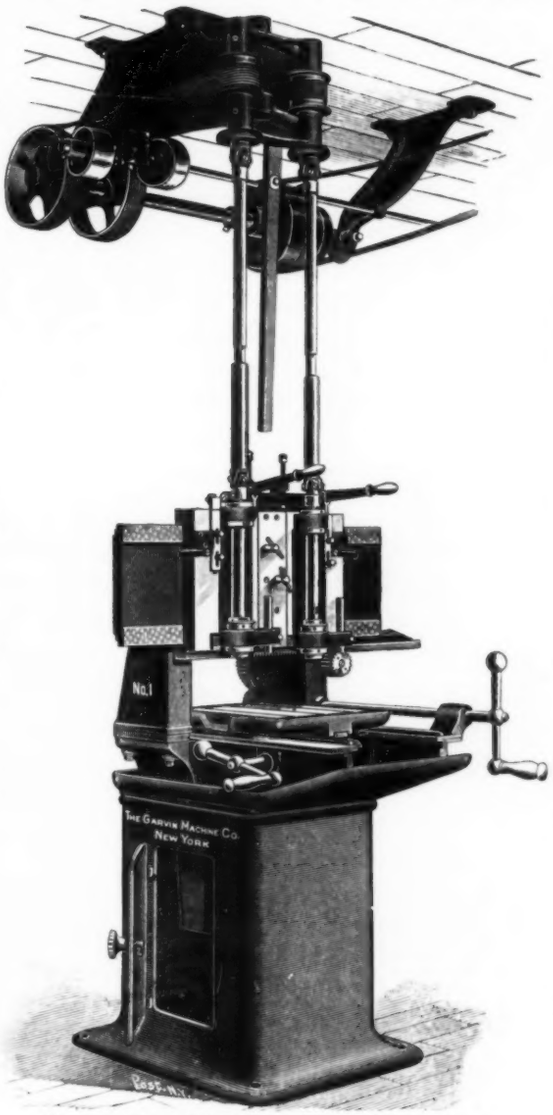
Simplicity of construction.

Very sensitive movement; uninfluenced by belts or sliding keys.

No heating at high speeds.

Independent direction of rotation for each spindle.

Built in five sizes.



No. 1. Two Spindle Profiler, Wesson Drive.

Advantages.

Solid construction, there being no opening in rail, rail heads or spindles for belts, etc.

Oil reservoirs formed in upright and base.

Very highest efficiency.

Endorsed by prominent manufacturers.

Catalog for the asking.

Immediate Delivery.

The Garvin Machine Co.

Spring and Varick Streets, New York.

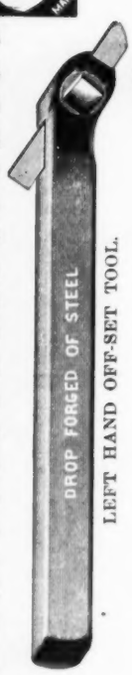
Philadelphia Store, 51 North 7th St.

DOMESTIC AGENTS.

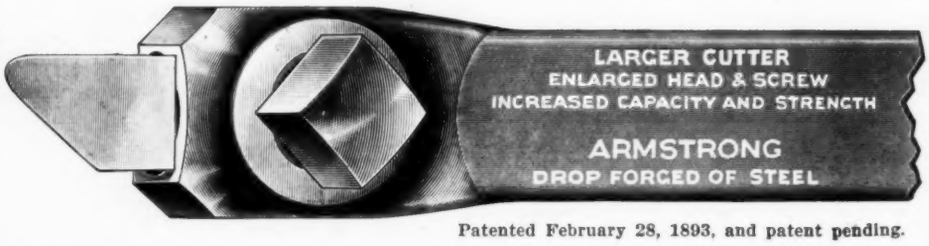
Manning, Maxwell & Moore, Chicago, Ill. Textile Mill Supply Co., Charlotte, N. C. Brown & Zortman Machinery Co., Pittsburg, Pa. W. P. Davis Machine Co., Rochester, N. Y.

FOREIGN AGENTS.

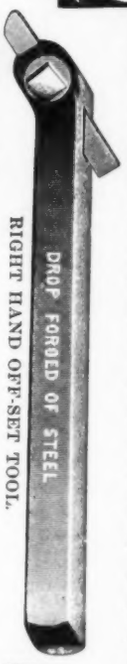
C. W. Burton, Griffiths & Co., London, England. Montgomery & Co., Paris, France. A. Engelman & Co., Brussels, Belgium. Deutsche Garvin Maschinen, F. A. G., Berlin, Germany.



LEFT HAND OFF-SET TOOL.



Patented February 28, 1893, and patent pending.



RIGHT HAND OFF-SET TOOL.

DEAR BILL:

The old man got me an ARMSTRONG TOOL HOLDER at last, and say, I have all the rest of the boys in the shop skinned.

Talk about a handy tool! Well, that's what-it-certainly-is; no trouble at all to keep it sharp, and the point always stays at the right height.

Say! That steel in the cutters makes our old forged tools look like thirty cents.

Sam Jones got a casting to turn up to-day that had a skin on it like chilled glass. After it had put all Sam's pet tools to the bad, my little old Armstrong walked through it without a squeak and came out smiling.

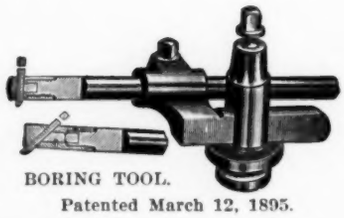
Say! What do you think of the Off-Set Tool Holders? I found an Off-Set Tool Holder Circular packed in the box with my tool. It looks good. Do you use any?

Yours cheerfully,

JIM

Patented Apr. 18, 1898.

Patented Aug. 19, 1902.



BORING TOOL.
Patented March 12, 1895.

Patented Nov. 14, 1899.

Patented May 28, 1901.

It Won't Pay to FORCE Your Men to Use Forged Tools

WRITE FOR CATALOG N.

ARMSTRONG BROS. TOOL CO.

"The Tool Holder People." **CHICAGO, U.S.A.**

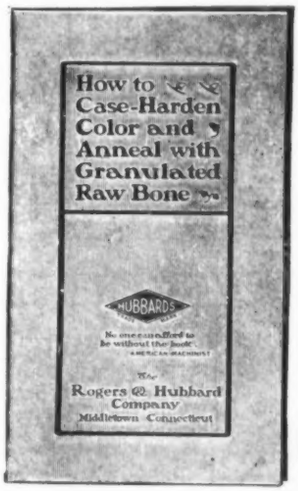
FOREIGN AGENTS—Chas. Churchill & Co., Ltd., London, Manchester, Birmingham, Glasgow. Schuchardt & Schutte, Berlin, Brussels, Vienna, St. Petersburg. G. Koeppen & Co., Moscow. C. S. Christensen, Christiania. Aikenhead Hardware, Ltd., Toronto, Canada. Williams & Wilson, Montreal, Canada.

Imitations Are Unsatisfactory—Infringements Are Unlawful.

"Lest You Forget"

about that little book — which comes free — on case hardening, annealing and coloring. This little book is worth its weight in 24-carat gold to anyone who has to do with steel in its heated processes.

Is full of directions and kinks for hardening, annealing and coloring in the best, surest and quickest ways. A copy ought to be in everyone's hands. Your copy is ready and comes on return mail after we receive your address. And it's free. No cost to you at all.



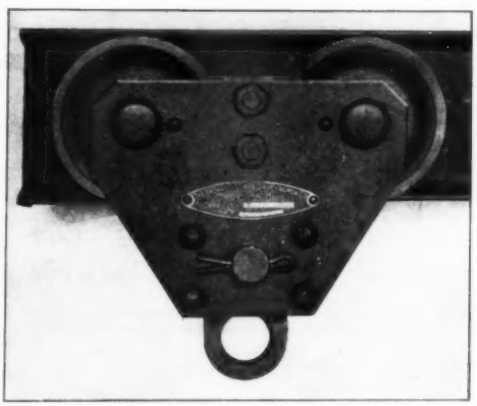
The Rogers & Hubbard Co.

Middletown, Conn.

"Brownhoist" Steel Plate Trolleys

ARE USED IN Machine Shops, Foundries, Warehouses and Works, from the Atlantic to the Pacific Coast.

They are conceded to be the easiest running and most substantially built trolleys on the market.



Side View of Brown Trolley.

Standard sizes kept in stock for prompt shipment.

End View of Brown Trolley.

The Brown Hoisting Machinery Company

WORKS: CLEVELAND, OHIO.

New York, 26 Cortlandt St. **Pittsburg, Frick Bldg.**

The American Wet Drill Grinder

With Electric Motor Drive.

The Latest and Most Improved Machine On the Market.

The right machine to buy for sharpening all kinds of drills, especially the larger sizes.

You Can Grind Fast Without Danger of Heating the Drill.

The water is driven in between the drill and the wheel on this machine, and the drill is kept cool. There is no guess-work about it; the water does go the right spot. The Water Guards are constructed to keep the water inside the machine where it belongs, and they do it.

The motor is mounted on the base of the column where it is the most out of the way and where vibration will least affect the grinding. It is completely enclosed and protected from dirt.

Catalog explains many other excellent features.

BARRE. L S H & S MASS., U.S.A.

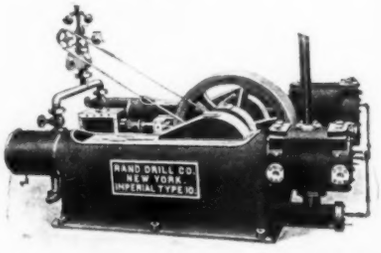
L. S. Heald & Son, 100 M Street, **Barre, Mass., U.S.A.**

Chas. Churchill & Co., Agents, London, Eng.

You must have air—

compressed air—in your shop to operate your pneumatic tools and hoists. You can't afford to be without it, and besides, we want to sell you one of our

Imperial Compressors.



RAND DRILL COMPANY,

128 Broadway, NEW YORK.

NORTON EMERY WHEELS

Quick Cutting
Uniform Quality
Wonderful Durability
Waterproof
Catalog Free

FOREIGN AGENCIES:

ENGLAND:
Buck & Hickman, London,
Chas. Churchill & Co., London, Birmingham, Glasgow, Manchester.

FRANCE: Fenwick Freres & Co., Paris.

OTHER EUROPEAN COUNTRIES:
Schuchardt & Schutte, Berlin, Vienna, Brussels, Stockholm, St. Petersburg, Koln.

JAPAN: F. W. Horne, Yokohama.

Walker Universal Tool and Cutter Grinder
Emery Wheel Machinery
Corundum Wheels
India Oil Stones

LARGEST PRODUCERS IN THE WORLD

NORTON PRODUCTS ARE THE STANDARD

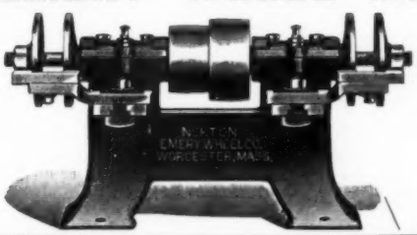
NORTON

THE BEST WHEELS FOR
TOOL GRINDING AND
GENERAL MACHINE SHOP USE—
SURFACE GRINDING—SAW SHARPENING—
KNIFE SHARPENING AND WOODWORKING TOOLS—
GRINDING CASTINGS OF ALL KINDS—
ALL FORMS OF CYLINDRICAL GRINDING,
INTERNAL AND EXTERNAL

NORTON

NORTON EMERY WHEEL MACHINERY

For Machinists' and Wood-Working Tools



For Bench and Floor
Latest and Best

Complete Illustrated Catalog Free

NORTON EMERY WHEEL CO.

Office and Works at
WORCESTER, MASS., U.S.A.

Chicago Store: 25 So. Canal St. "Agencies: All over the World"

See that Sign

It stands for Goodell and for Goodness—for the best that the best of materials and methods can produce in Hack Saw Blades. The Hack Saw Blade with a

Ⓖ

on it is tempered all over like a file. It's a fast-cutting, long-lived blade that has become the generally recognized standard for comparison wherever hack saw blades are used.

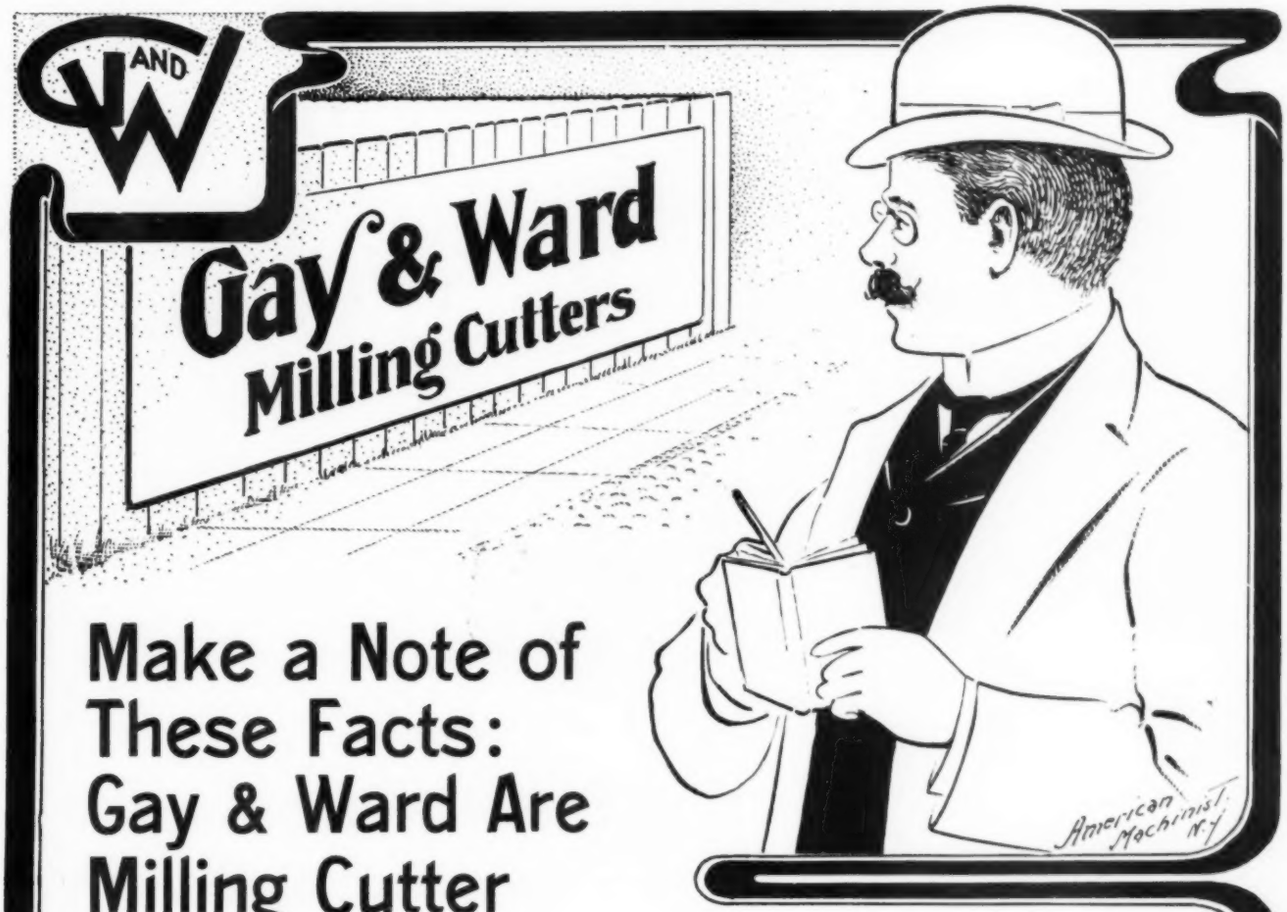
The manufacturer owes it to his men, and the men owe it to the manufacturer, to insist on using blades marked

Ⓖ

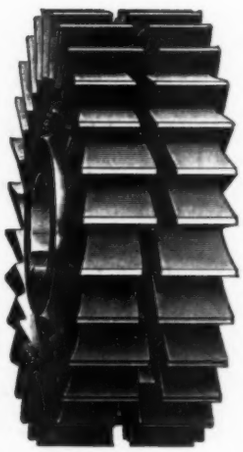
"Just as good" is only a tribute to their superiority and should be so understood.

Goodell-Pratt Company,

Greenfield, Mass., U.S.A.

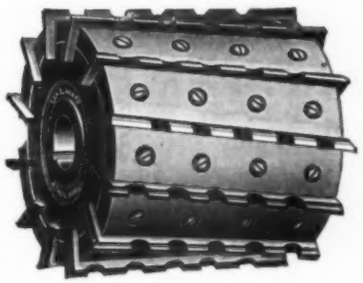


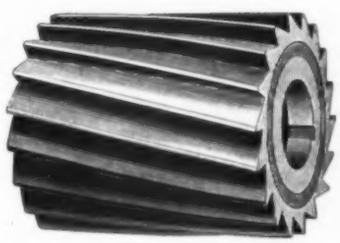
Make a Note of These Facts: Gay & Ward Are Milling Cutter



specialists, they make nothing else. These Milling Cutters are made by experts from beginning to end, by people who make nothing else; they are made on machines especially devised for the work; they are made in an infinite variety covering just about every milling cutter possibility; they are proper in design; the price is always right. People use Gay & Ward Cutters because they afford financial satisfaction both in first cost as well as in quality and quantity of the work they will handle.

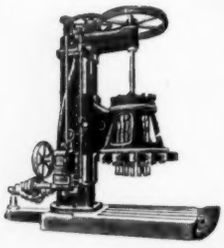
Gay & Ward have a Catalog which illustrates many of these Cutters. This Catalog they are pleased to send on request.





Gay & Ward, ATHOL, MASS.

Chas. Neat & Co., London, England.



Both Ends

of a cylinder or pipe flange can be drilled in one operation with our

Horizontal Multiple Spindle Drill

We build

Vertical Spindle Drills

also as shown in above cut; they are fitted with automatic stop and feed, insuring great ease in operation.

Accuracy of centers is always assured with these machines.

Built in sizes from 4 to 24 spindles.

Our

Universal Joint

for revolving a shaft outside a straight line—is strong and simple.

Send for folders giving particulars.

Baush Machine Tool Co.
SPRINGFIELD, MASS.

Agents: Manning, Maxwell & Moore, New York, Chicago, Philadelphia, Boston, Cleveland and Pittsburg. Selig, Sonnenthal & Co., London. Chas. Churchill, London, Birmingham, Glasgow, Manchester and Newcastle-on-Tyne. Fenwick Freres & Co., Paris.

Made of Bronze or Steel.

Our Universal Joint.

No. 7. DESK SET.

The Clark Automatic Telephone System.

An intercommunicating system that has passed all experimental stages and comes to you tried and proven to be of real value.

It is for shop communication especially; it avoids all troubles usually found in such shop telephone systems, and saves much time in the conveyance of information to those who are to be informed, in the most direct way. It is always ready and always in order.

A few points of excellence have mention here: The Clark avoids all central office expense; avoids all complexity of wiring, such as is the case with the plug system; gives perfect service day or night; permits connections being made at the will of the party calling; allows any number of conversations to be carried on at the same time without interfering with each other; is durable, and does not get out of order easily.

It will save you its cost in a very short time. Its first cost isn't much and you can well afford its use. All particulars and testimony of users in our catalog No. 7, free.

The Clark Automatic Telephone Switchboard Co.,

15 Custom House Street,
Providence, R. I., U.S.A.

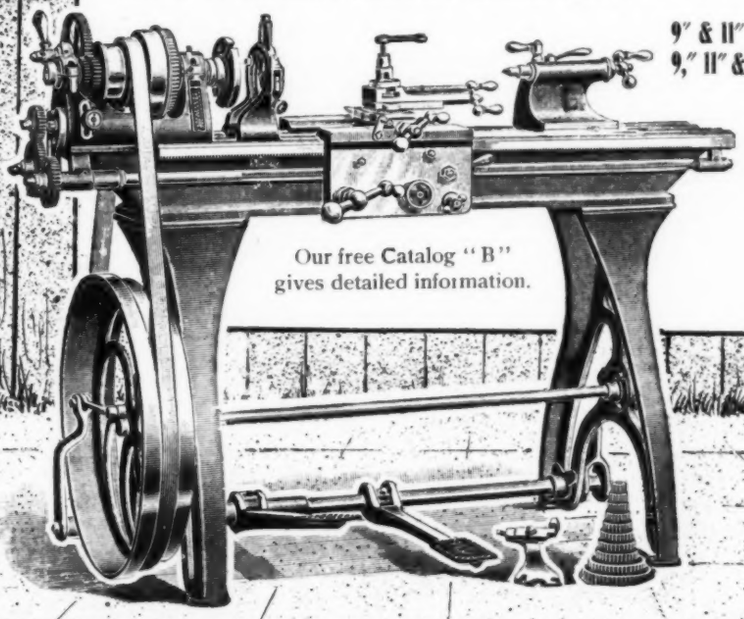
No. 27. WALL TELEPHONE.

If you're "on the fence"

In the matter of buying a lathe of 9- to 13-inch swing, a careful investigation of the

"Star" Foot and Power Lathes

will help you to a decision that will bring no regrets. The "Star" is the "bright particular star" of the entire lathe firmament—easily the best of its size and kind that money will buy. We are not blinded to future business—to repeat orders—by undue consideration of present profits, and every "Star" Lathe that leaves our shops is just as nearly right as correct design, good materials and skilled workmanship can make it, in spite of its low price. It is useless to pay more than we charge for a lathe of 9- to 13-inch swing; and it is decidedly doubtful economy to pay less. "Star" Lathes have forged crucible steel hollow spindles, phosphor bronze bearings, graduated cross-feed screw, improved interchangeable plain and compound rests with graduated base, exclusive gear-driven cross and longitudinal feeds. Can furnish with draw-in chuck and collets, gear-cutting, milling and taper attachments. "Star" Lathes are suitable for light machine shop and tool room service, model makers, gunsmiths, technical schools, etc.



Our free Catalog "B" gives detailed information.

9" & 11"
9," 11" & 13" "Star" Foot Lathes. Power Lathes.

The Seneca Falls Manufacturing Co.

687 Water Street,
Seneca Falls, N. Y., U.S.A.

American Machinist

Modern Machine Shop Methods

demand of every machine the highest possible

ACCURACY, ADAPTABILITY AND AMOUNT OF OUTPUT

In these most important points, as well as many minor ones,
we have *proved* the superiority of

The GRIDLEY
AUTOMATIC TURRET LATHE

MORE ACCURATE, because
The tools do not overhang.
A better design of turning tool can be used.
Drills are supported close to the work.
The design of the machine is such that it is stiffer.

GREATER OUTPUT, because
Heavier cuts and coarser feeds can be taken.
Two or more cuts can be taken at the same time.
It does not take so long to "set up."
Tools of greater efficiency can be used.

WIDER RANGE OF WORK, because
It will do work other machines can not do.
It can be used for work in small quantities.
The tools are adapted for working tool and nickel steels.
It will cut fine pitch threads on large diameters.
Taper and irregular shapes can be readily turned.
There is sufficient room to attach special tools that cannot be used on other machines.

Ask us about it.

Made and Sold only by **Windsor Machine Co.,** Windsor, Vt., U. S. A.

We Make a Full Line of Grinding Machinery.

Motor Driven Water Tool Grinder.

Carries Wheel 20-inch Diam.

Water Cannot Get Onto Motor.

Perfect Control of Water.

Machine Entirely Self-Contained.

Motor Sets in Bottom of Frame and is Covered by Shield Shown.

NEAT. HANDY.

Ransom Mfg. Co.,

Oshkosh, Wis.

Multiple Parts

Of almost every description can be made on Cleveland Automatic Machines from rods of steel, brass, copper, aluminum, cast bars of iron or brass, and odd shaped castings, by using magazine. Cleveland Automatic Machines are entirely automatic, absolutely accurate and very durable.

One man can operate a number of machines. Every piece turned out means a saving. Our machines soon pay for themselves. They do coarse and fine work equally well. Investigation may save you many dollars. Submit samples of your output and we will give you estimate of its cost of production on Cleveland Automatic Machines. We believe it will interest you. Write for Catalog.

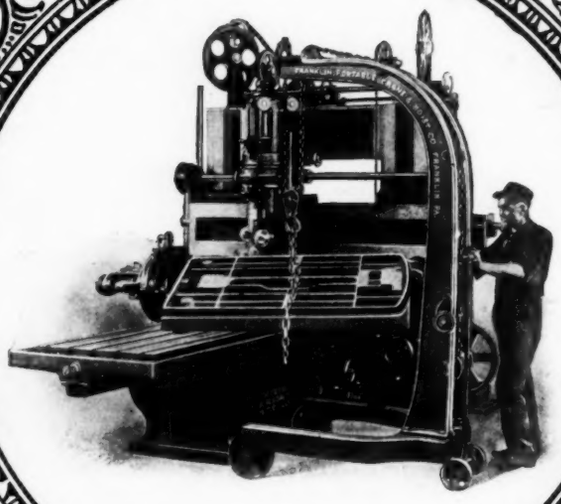
Cleveland Automatic Machine Company,

Previously known as The Cleveland Machine Screw Co.,

CLEVELAND, OHIO, U.S.A.

We also manufacture Automatic Worm Milling and Chucking Machines.

FOREIGN BRANCHES—Messrs. Chas Churchill & Co., London, Manchester, Birmingham, Newcastle on-Tyne and Glasgow. Messrs. S huchardt & Schutte, Berun, Vienna, Brussels, Cologne, St. Petersburg and Stockholm. Romain Talbot, Paris.



There Never Was a Better Way to Handle Work About The Shop

than by using the Franklin Portable Cranes and Hoists, and probably never will be. The advantages over all other methods are many. Thro' their use you are enabled to handle work in places inaccessible to traveling cranes or fixed hand cranes. They handle loads up to two or three tons very easily, they take the load right up and deliver it on the spot—not somewhere in the vicinity, but right on the mark. There are many places about your shop where you couldn't instal a crane of any kind if you wanted to; your only method is to take anywhere from five to ten men and move things that way; and every time you do it your good profit gets a fat slice taken off. Franklin Portable Cranes are handled by one man and the loads have easier transfer than you could get by forty men. When you are not using it you can shove it into a corner out of the way. The cost is little, the service great. You would do well to investigate NOW.

The Franklin Portable Crane and Hoist is forever ready. It goes anywhere, everywhere; it minimizes time and labor; it is an investment of much dividend value, and ought to be in your shop now.

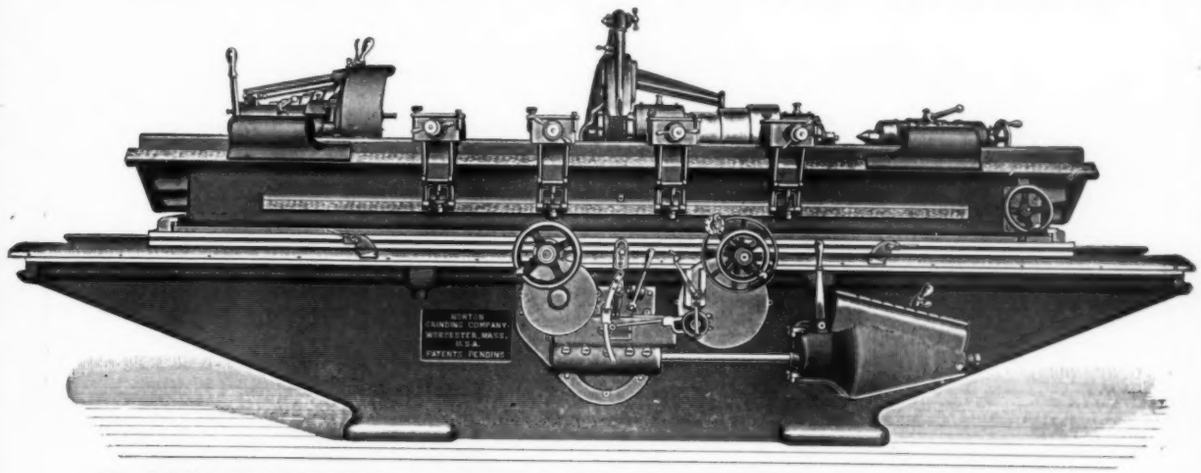
The construction of these Cranes is such as to insure the greatest strength and durability. Every part is carefully made and put together, and only the very best of materials are used. All machines are roller bushed.

The Franklin Portable Crane and Hoist Co.

Franklin, Pa., U.S.A.

American Machinist

NORTON PLAIN GRINDING MACHINE



IT INAUGURATES A NEW ERA IN COMMERCIAL GRINDING.

CAPACITY, 8 FEET BETWEEN CENTERS. 18-INCH SWING.

FOR TAKING THE FINISH CUT INSTEAD OF THE LATHE.

IN ADDITION TO THE MANUFACTURE OF GRINDING MACHINERY WE MAKE A SPECIALTY OF MACHINE GRINDING AND MACHINE GROUND PARTS.

Norton Grinding Co., WRITE US FOR CATALOG AND PARTICULARS. **Worcester, Mass., U. S. A.**

WITH THE KNOCK OF THE POSTMAN

comes a

TECHNICAL EDUCATION

of the Highest Quality to Your Very Door.

Instruction by correspondence in the following subjects: **Mechanical, Electrical, Civil, Marine, Locomotive, Stationary and Sanitary Engineering, Navigation, Hydraulics, Architecture, Telegraphy, Sheet Metal Work, Mechanical and Perspective Drawing.** Also forty short Special Courses.

Instruction under Members of the Faculty of the Armour Institute of Technology.

Textile Course Under Foremost Authorities.

Young men not having the means to spend four years at college can begin their education in the American School of Correspondence, and later complete their courses by actual residence at the Armour Institute of Technology, as all work satisfactorily passed by students will be accepted by the Armour Institute. An exceptional opportunity to round out practical work with a course under teachers of recognized educational standing, who have at their command the equipment of a great resident technical school for testing and experimental work.

WE HELP OUR STUDENTS.

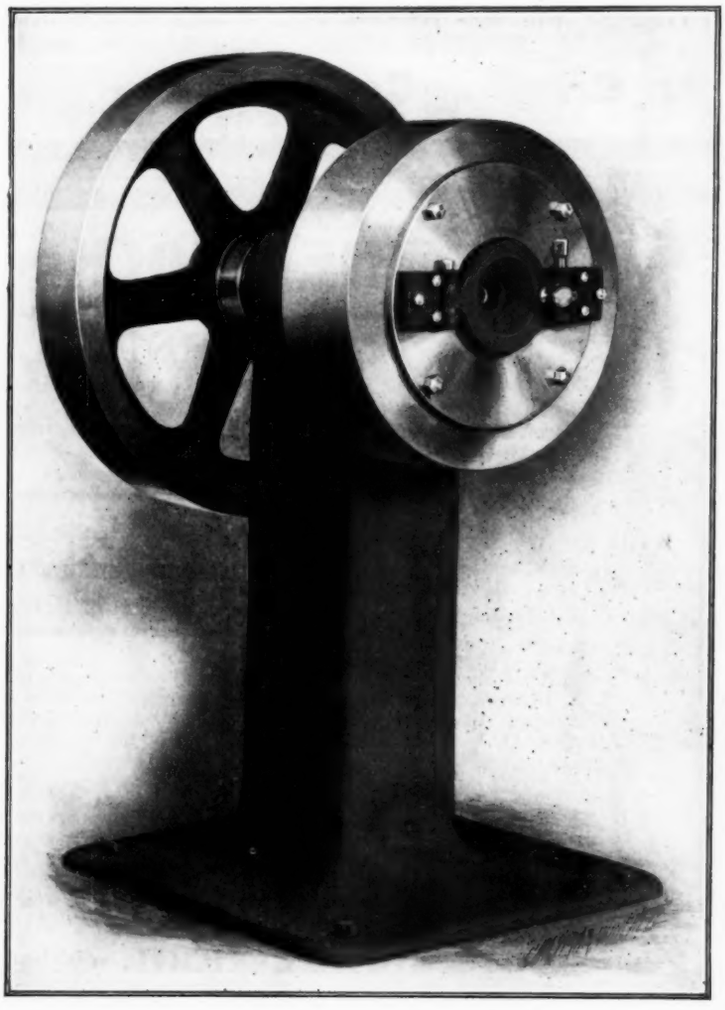
The excellent evening classes of the Armour Institute of Technology offer unusual opportunity to our students to combine shop and laboratory practice with correspondence instruction at a nominal expense. To encourage our students to avail themselves of these opportunities, the school makes a special effort to assist them to positions in Chicago.

A Technical Reference Library (ten volumes) included with each full engineering course. Full particulars and a catalogue of courses may be had upon request. State subjects interested in.

AMERICAN SCHOOL OF CORRESPONDENCE
AT
ARMOUR INSTITUTE OF TECHNOLOGY,
CHICAGO, ILL.

SWAGING

Is the proper method to employ on all reductions of metal. The gain by swaging comes in the saving of metal, which is lost in turning, milling or grinding processes. It keeps the molecular constitution of the metal intact. It solidifies and strengthens the material. Swaging in a modern way is best done on the Dayton Swaging Machine here shown. In operation the Dayton Machine is a distinct departure from usual methods. The swaging is done by dies. These dies, which are adjustable in their relation to each other, are carried in a slot in the face of a revolving mandrel, and are held between a pair of blocks with rounded ends. Outside of and around the mandrel is an annular rack containing loosely a number of steel rollers. The revolution of the mandrel causes the dies and blocks with rounded ends to pass between successive pairs of opposing rollers, which force the dies together. The mandrel is hollow to permit the work to feed thro'. The dies revolve rapidly around the work, which is stationary, while the rack containing the rollers revolves very slowly. The blows on the work —or "squeezes" might be a better term—approximate from 2,000 to 6,000 per minute, according to the size and style of machine. The work has an even, smooth reduction in this way, and, while the reduction is rapid, there is time enough for the metal to assume its true molecular condition.



We make these machines from the smallest size for use on bench to the largest and most powerful floor machines.

A full treatise on Swaging is free.

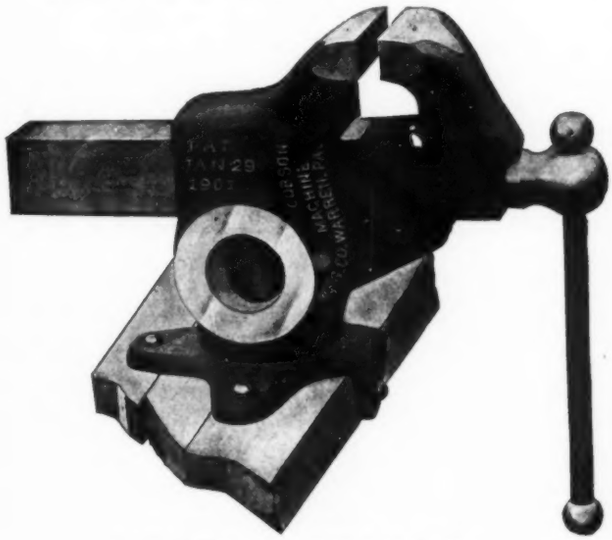
EXCELSIOR NEEDLE COMPANY,

Torrington, Ct.

Coventry Swaging Co., Ltd., White Friars Lane, Coventry England, Agents for Great Britain. Fenwick Freres & Co., 21 Rue Martel, Paris, France, Agents for France, Italy, Belgium, Portugal and Switzerland.

The Jacobson Swivel Bottom Bench Vise

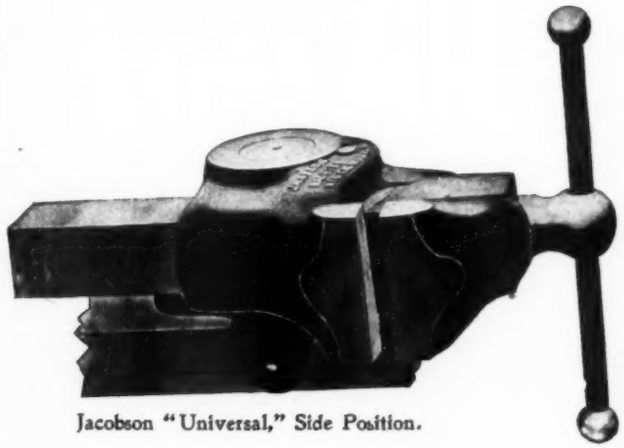
Is wholly unlike, and better than any other vise of its type. There's no screw under the bench to monkey with and lose time on—no pins in the base to wear and work loose, allowing the vise to wabble with every stroke of file or hammer. You get exactly the adjustment you want, down to a hair's breadth, and lock the vise securely by a single turn of the handle; then another turn grips the work so tightly as to make it almost a part of the vise itself. A blow that's heavy enough to dislodge the work will not budge the vise on the post. This is a Vise you need in your everyday business. You need it anywhere and everywhere that a swivel bottom vise can be used. You need it because it fills the bill as no other swivel bottom vise will, and saves time and trouble on every job. It costs just about the same, but has greater capacity and convenience. The Jacobson 5¼" "Swivel Bottom" Vise opens 10½", where an ordinary 6" "swivel bottom" opens only 9". Other sizes in proportion. It's heavy enough, and strong enough, you'll find. Why don't you try one at our expense? We're getting duplicate orders from some of the biggest concerns in the country, and some of them are using it exclusively.



Jacobson "Universal," Upright Position.

In the Tool Room, On the Drill Press—

In fact, wherever the fine work is done, you need the Jacobson "Universal" Swivel Vise, and no other will do quite as well. Has the same secure, time-saving locking feature and the same capacity; but has the additional advantages of a practically unlimited range of adjustment—swivels instantly in either horizontal or upright position. It's great for drill press use. You make a special post and pieces can be drilled in every conceivable position. Saves a lot on special jigs and fixtures, to say nothing about time. People who use the Jacobson Vises tell us that they pay for themselves very quickly, and that no shop, big or little, that values time and modern methods, should be without them. You ought to have our printed matter and you ought to have it now. A postal will bring it.

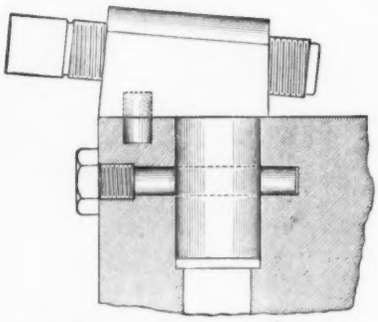


Jacobson "Universal," Side Position.

For sale to trade through our nearest distributing agents as follows:

New York: Armstrong, Walls & Co. Pittsburg: Brown & Zortman Machy. Co., Baird Machy. Co., Pittsburg Gauge & Supply Co., Somers, Fitler & Tod Co. Boston: Cutter, Wood & Stevens Co. Cincinnati: E. A. Kinsey Co. Detroit: Buhl Sons' Co., C. C. Wormer Machy. Co. Cleveland: McIntosh-Huntington Co.

Jacobson Machine Mfg. Co., Warren, Pa.



Method of Holding Poppet.

This shows our method of fitting our Poppets to Drops and shows manner in which they are held in position, both as to upward movement and also to keep them from turning. They hold the die as accurately as a lathe chuck jaw holds its work.

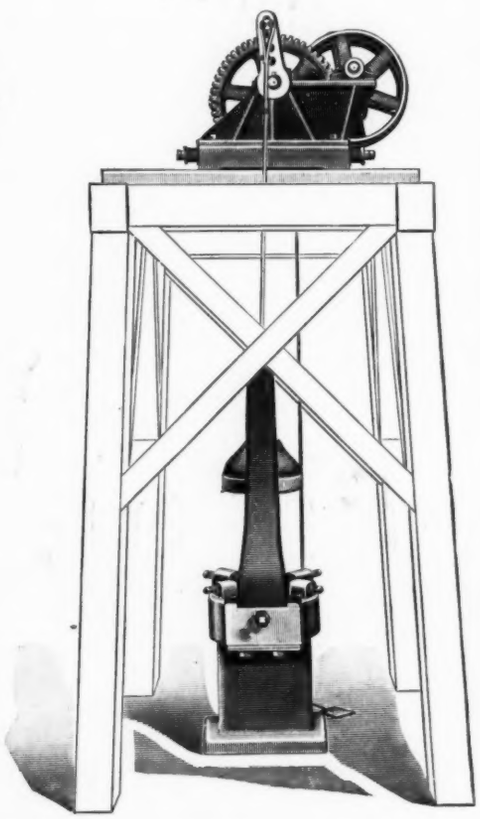
The Peck Automatic Drop Lifter

enables you to put very ordinary operators onto your drop press work; 'tisn't necessary to have high-priced men doing the work, and the difference in wages makes drop press work worth while. The Peck Automatic Drop Lifter goes over any drop press in place of your present shaft and pulleys, and increases your output. It can't be jarred to pieces because it's separate from the press itself and isn't jarred by the impact of the drop. It can be operated with the greatest safety, and both hands are available for the work; the blow will be more uniform and heavier than the same weight of hammer raised by strap over friction pulleys. Anyone who can operate a punching or blanking press can operate this drop. It's the real, sensible way to do this kind of work and if you feel that a little more profit from your drop press work would not come amiss we hope you will institute an investigation. This isn't a new scheme; it's no experiment for you to try at your own cost; it's been tried and has been proven.

We make these lifters in twelve sizes, with capacities for working from 50 lbs. to 5,000 lbs.

The illustration shows drop used for stamping sheet metal, but we manufacture them also for forging and have a special line which we make for spoon makers and other silverware manufacturers.

All details are sent on request and we shall be pleased to hear from you.



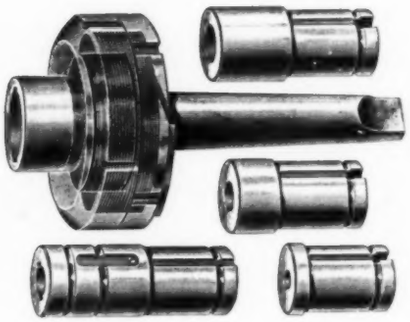
Miner & Peck Manufacturing Co.,

PROPRIETORS OF

THE PECK DROP PRESS WORKS,

419 Chapel Street,

New Haven, Conn.



The Safety Drill and... Tap Holder

for use on upright drills, lathes or any machine with revolving spindle, is simple, is devoid of dainty breakable parts, has no gears, is light and easily handled. Changes of tools may be made while spindle is in motion.

Work is produced very much faster than by other methods and results are always accurate. Power is transmitted by friction adjustable to requirements of the work.

This is a time and labor-saving tool that ought to have a place in your shop for your own good financial end.

A full detailed description is sent on request, and your inquiries are invited.

The Beaman & Smith Co.,

Providence,
R.I., U.S.A.

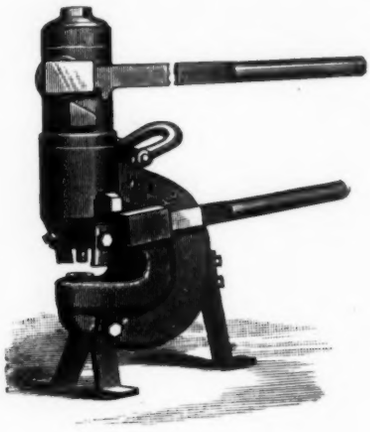
RAWHIDE GEARS

ARE

LIGHT, DURABLE,
CLEAN, ELASTIC,
STRONG, NOISELESS.

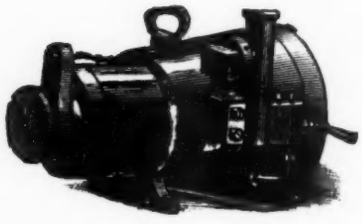
The "HIGH GRADE" are manufactured by

Horsburgh & Scott, Cleveland, O.



Jack Makers to the Great Wide World,

makers of every kind of jack in use; pushing jacks, lifting jacks and pulling jacks. Most of them hydraulic, but some folks need screw jacks, so we have those.



Can you imagine 257 different kinds of Jacks? That's the number of varieties we make, and, being headquarters for this line of goods, we know a thing or two about the business that you get the benefit of without having to pay anything extra for it.

Our No. 1 Portable Shaft Straightener, For 24-inch Lathe,

is an adaptation of a jack in a most ingenious way. It straightens a shaft right on the bed of a lathe. Wheels back and forth between the V's and bends up to 3½ inches easily. It may also be used as a portable shop tool and is useful in a hundred ways. This is described in "Sheet 546."

Our "Jack Book" will give you information about everything in Jacks.

Watson-Stillman Co.,

202 East 43d Street,

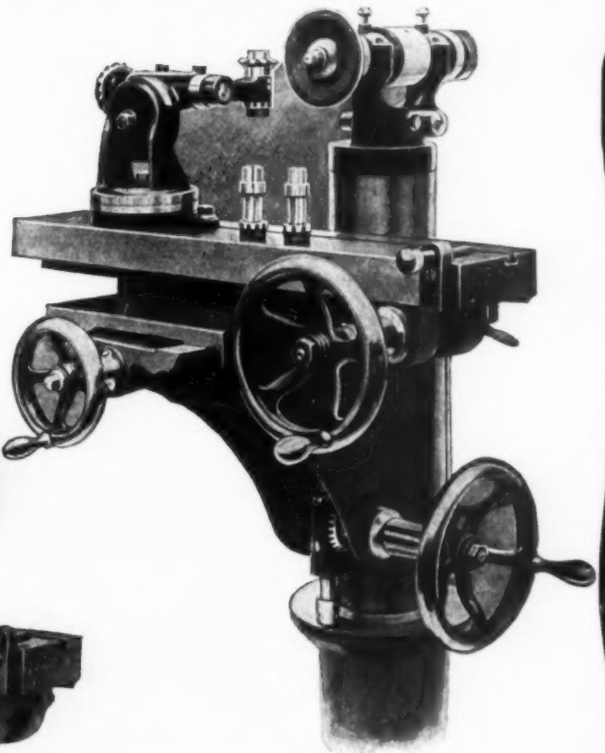
New York City.

Chicago Office: 453 Rookery.

Selig, Sonnenthal & Co.: London.

Adolphe Janssens: Paris, France; Brussels, Belgium.

This Is Our Universal Grinder.



It is for grinding milling cutters, all shapes; taps, reamers, arbors, keys, gauges, holes in cutters or other articles, the edges and sides of flat, square, hexagon, octagon and other shapes and operations kindred thereunto. The work produced is always quite right in every way and is handled very rapidly. It is a tool that'll save you many dollars.

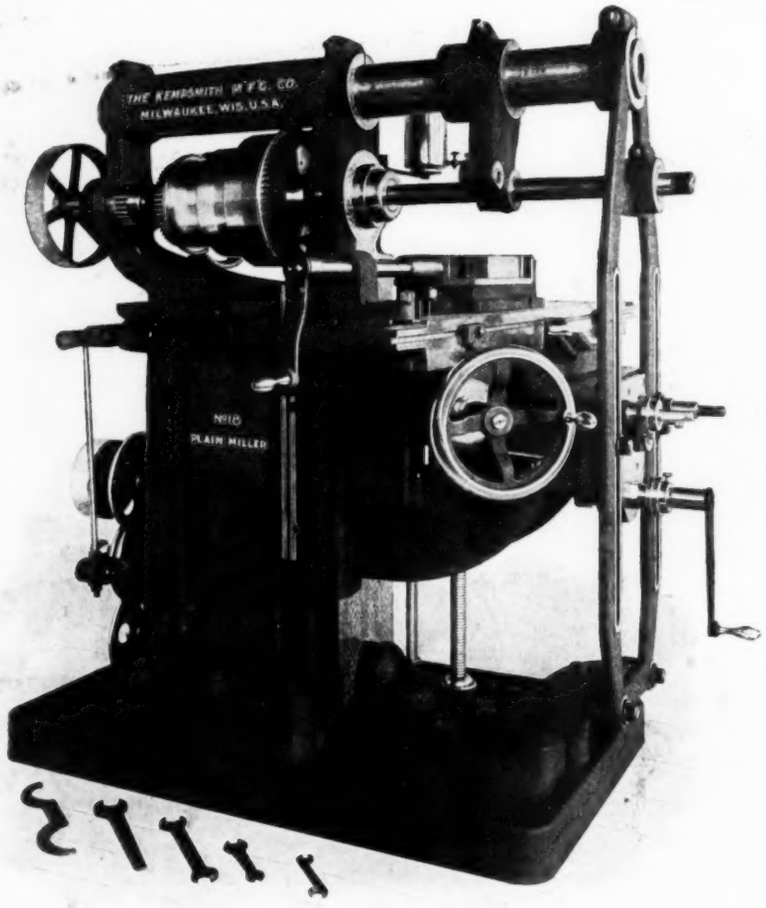
This grinder comes all the way through expert hands, has had clever design, careful workmansh and the use of choice materials. It will handle more work and more kinds of work, and in a better manner than any other grinder made anywhere by anyone. It is convenient, is always ready, is free from fussy details, is durable, is forty and one other things that go to make a proper grinder. Its use will save you much money. Its first cost, which is the whole cost, is less than you might think. We shall be pleased to send you all details and hope to hear from you.

Greenfield Machine Co.

Greenfield, Mass.

KEMPSMITH QUALITY

means a Milling Machine quality that finds its immediate results in the faster production of better work. Some evidences of Kempsmith quality are here set forth : The column is generously proportioned, is not made heavy for appearance sake, but to serve a useful purpose, that is, to give the Miller strength and rigidity. The column is strongly ribbed and so ribbed as to produce interior shelving for the storage of tools and cutters. Spindle is hollow the full length and is made from forged crucible steel, ground its entire length; bearing boxes are of bronze. Overhanging arm has intermediate pendant for long arbor support. Outer brace or harness extends from miller base to arm ; note the rigid appearance. Arm may be pushed back to clear column face for end milling on unusually large work. The feed device (Sellers' Friction Disc) will pull main belt to a standstill. These are but a very few of the many points of merit. We are pleased to send handsome catalog which describes and illustrates fully. You should have this book, should look thro' it carefully and should investigate, all for your own good.



50 x 10 x 22½ in.
Automatic Longitudinal, Transverse and Vertical Feeds.

THE KEMPSMITH MANUFACTURING COMPANY

MILWAUKEE, WIS., U.S.A.

C. A. Mosso,

MANUFACTURER OF

Mosso's Monarch

TEMPERING COMPOUND.

Dryden, N.Y.

Mosso's Monarch Tempering Compound.

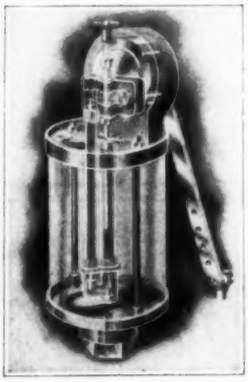
I manufacture a compound that does away with all trouble in the tool room. A twist drill can be hardened to drill any chilled cast iron or self-hardening steel made. A thin chipping chisel will stand the blows of a twenty-pound sledge and won't break, bend or upset; and keep a keen cutting edge four times as long as the old way. All changes of water checks are done away with. Milling cutters will do from three to ten times the work and never crumble on the corners or fine points. It will not evaporate or deteriorate by age. I can furnish the names of prominent firms who have used it from four to fifteen years. I will send 25 gallons for 30 days' trial to any responsible parties; no charge if not satisfactory.

It improves all grades of steel.

C. A. MOSSO, Dryden, N. Y.

Used same as water in hardening. **No extra skill required.**

Positive Lubrication



FOR ALL CLASSES OF ENGINES

THE

PENBERTHY

FORCE FEED LUBRICATOR

(McClure Patent.)

Works Equally Well on High Speed or Low Speed Engines.

The Roller Bearing Driving Mechanism

Secures a **positive feed** at any speed of engine, while the regulation is such that any desired quantity of oil can be fed.

This cup works equally well with either

Light or Heavy Oils.

Descriptive circular will be sent on request.

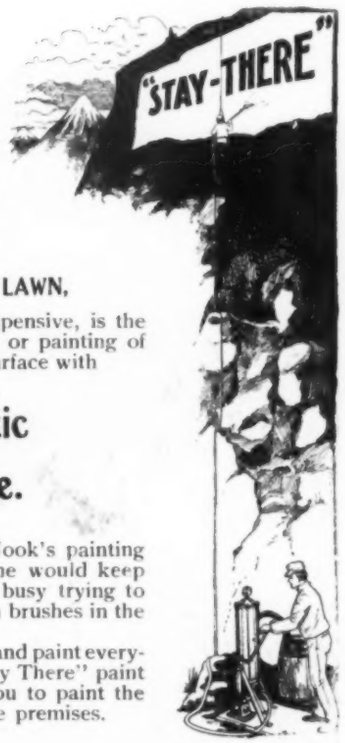
Penberthy Injector Co.,

348-360 Holden Ave., Detroit, Mich.

Largest Injector Manufacturers in the World.

Away Up There,

above reproach, beyond competition, sky-high in public favor is the "Stay There" (weather and fire proof) paint.



AS EASY AS SPRINKLING A LAWN,

and but a trifle more expensive, is the system of liquid coating or painting of the largest or smallest surface with

Hook's Pneumatic Coating Machine.

One man operating a Hook's painting or whitewashing machine would keep twenty good workmen busy trying to follow him, painting with brushes in the old-fashioned way.
Own your own machine and paint everything in sight with "Stay There" paint for what it would cost you to paint the smallest structure on the premises.

F. E. HOOK, Manufacturer,

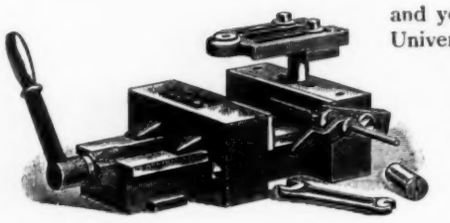
30 to 45 HOOK BUILDING,

HUDSON, MICH., U. S. A.

SEND FOR CATALOG, PRICES, ETC.

IN DUPLICATE DRILL WORK

SET THE FIRST PIECE CAREFULLY



and you can put in the rest of them without wasting any time in setting. Our Universal Jig Vise when once set, is set as long as you want it so. You move the work on the table instead of moving the table on the drill arm, and every piece is sure to be drilled exactly right. No need of bolting the work to either the drill table or the angle plate. Look at the prices and just figure in how many hours the "Universal" will pay for itself.

Details will be sent on request, or we'll send the vise itself if you'll try it.

No. 3 —Jaws 6 in. long, 1⅜ in. deep, will open 4½ in.; weight, 32 lbs. . Price, $20.00
No. 4.—Jaws 9 in. long, 2 in. deep, will open 7 in.; weight, 65 lbs. . . Price, 25.00
No. 5 —Jaws 12 in. long, 2½ in. deep, will open 9⅝ in.; weight, 135 lbs. . Price, 30.00

Graham Manufacturing Company,
Providence, R. I., U. S. A.

Canadian Makers: The Imperial Vise Co., Galt, Ontario.
European Agents: Selig, Sonnenthal & Co., 85 Queen Victoria Street, London, Eng.

Here's a Tool Holder You Ought To Know About.

It takes right hold of the tools and grips them with a good firm grip that doesn't allow the tool to go down, back, or twist around until you will it. Just a quarter turn of the handle releases the tool without removing the holder. An assortment of over twenty just such tools and fixtures that you use every day comes with it—not common tools but tools made from high grade tool steel of the best quality. Any tool can be furnished promptly and at a price less than redressing and grinding an old style tool.

HOLDER WITH DIAMOND POINT TOOL IN POSITION.

Want full particulars?

The "O.K." Tool Holder Co., Shelton, Conn., U.S.A.

The No. 2 U. & W. Piston Air Drill

DRILLING,
REAMING,
TAPPING, In close quarters.

Weight, 27 lbs.
Capacity—
Drilling in steel up to 2 inches.

The Columbus Pneumatic Tool Co.,
Office and Works:
Columbus, Ohio, U. S. A.

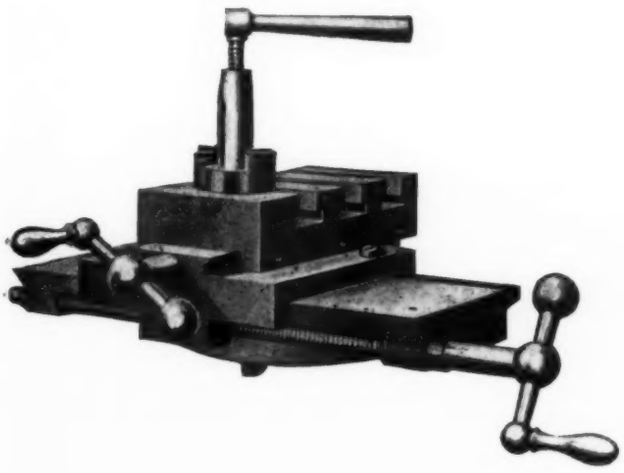
Here's A Good Grinder For Cutters and Reamers.

It's a good deal cheaper than the high-priced "Universals", but it has many of the features that make the "Universals" high priced.

This is a very good tool for qrindinq Milling Cutters (straight or spiral), Taps, Taper Reamers or Lathe Tools, as well as for surface qrinding over surfaces 8″ x 4″.

With a special attachment it grinds all kinds of involute gear cutters which require qrindinq on the face and, in fact, you can do pretty much everything on this that can be done on a "Universal."

A Good Many Lathes Look Alike.

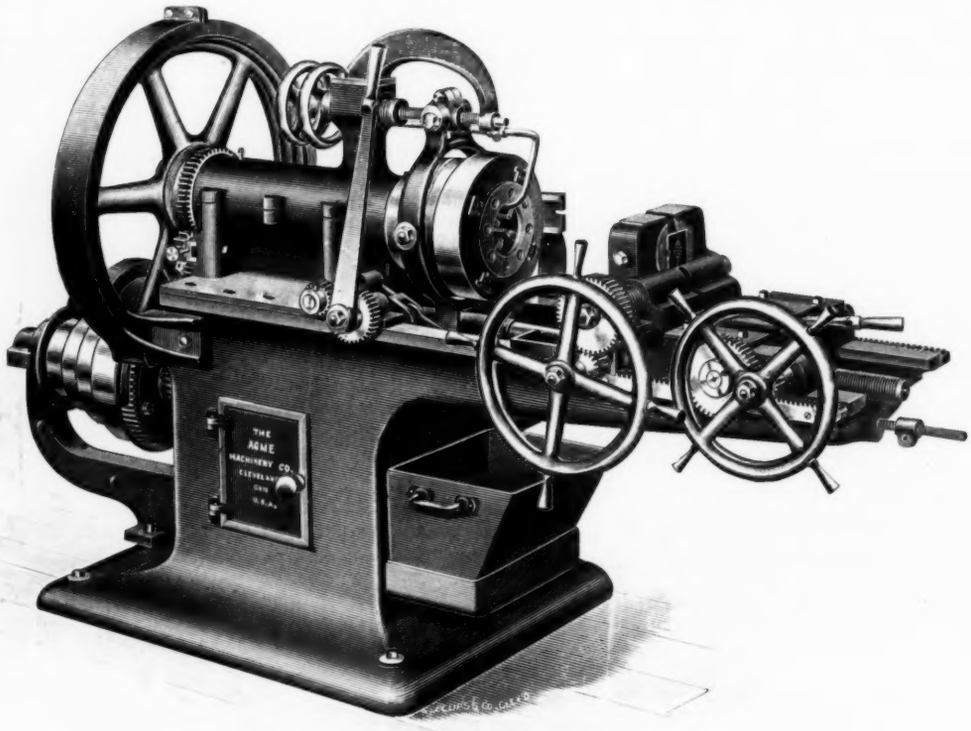


and it is in the details and attachments that you must look for the time-saving features.

This slide rest of ours is one of the details that add to the efficiency of our lathes. It is made from new and improved patterns and possesses a lot of winning points. All the wearing surfaces are carefully fitted by scraping. The screws are made of steel and protected against dirt and chips. They are mounted on a swivel base, which permits them to be set at any angle desired. The adjustable washer is fitted with five steps for elevating the tool, a very important feature, as the tool may always be straight—not tipped up, destroying the angle of cut.

The Lathes themselves are shown by some very life-like pictures in our catalog, which also contains our other specialties and which we will gladly send you on request.

Automatic Machine Co., Greenfield, Mass., U. S. A.



3-INCH ACME BOLT CUTTER WITH LEADSCREW ATTACHMENT.

Before buying anything you may want in

BOLT and NUT MACHINES

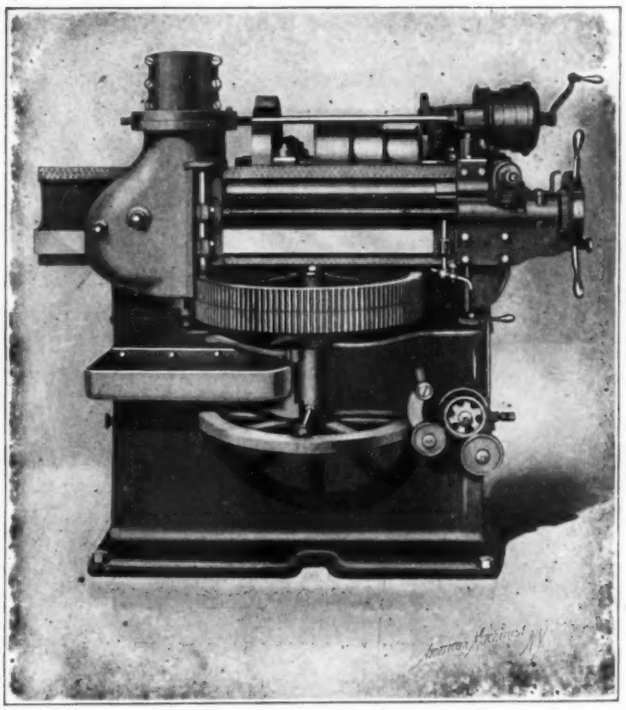
See our newly designed line of

Single, Double, Triple and Quadruple Bolt Cutters,
Four and Six Spindle Nuttappers,
Bolt Pointers, Etc. Bolt and Rivet Headers.
Upsetting and Forging Machines up to 4 in. Capacity.
Also Automatic Nuttapping Machines with Capacity up to 1 in.

The Acme Machinery Co.,

Cleveland, Ohio, U.S.A.

FOREIGN AGENTS—Schuchardt & Schutte, Berlin, Cologne, Vienna, Brussels, Stockholm, St. Petersburg. C. W. Burton, Griffiths & Co., London, England. Establishment Adolphe Janssens, Paris.

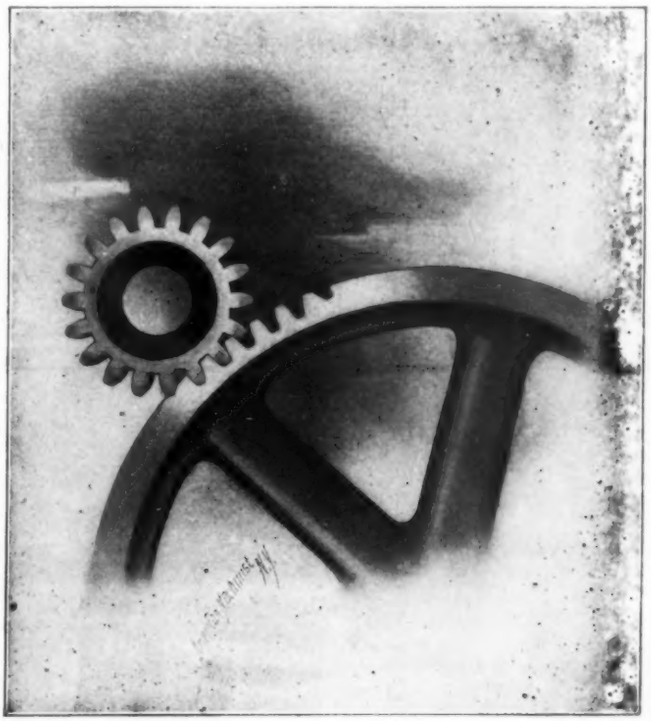


The Fellows Gear Shaper

is for accurate gear cutting in the fastest way, and for overcoming the shortcomings of other methods for cutting gears. It is no experiment, is nothing built in the exploitation of a hobby or notion. It is of positive practical value and a means to a gear making end which finds its results in larger dividends thro' better work and more of it.

The Fellows Gear Shaper, first of all, cuts a theoretically correct tooth. Because the tooth curve of the cutter is ground after hardening, the cutter and the work produced by it approach closer to absolute perfection than can possibly come thro' any other methods. There is only one cutter for each pitch. Here is a saving of 75% in cutters alone, to say nothing of the time, space and the bother of taking care of them. The Gear Shaper will produce more gears in a day than can be produced in other ways, and they'll be better gears. An error in spacing is an impossibility. It is not necessary that the cutter be set absolutely on the center. Does not take a mechanical engineer to operate it. The common, every day workman can produce as good work as the expert. Cutter travels the length of face of gear and no more. There is no 40% or 50% waste as is the case with rotary cutters. It will plane internal gears. It is cutting upon several teeth at once. The cutter cuts with a shearing cut and does not break out the blank at end of cut.

The Fellows Gear Shaper comes to you positively guaranteed to certain results. This guarantee guarantees without quibble or ifs, buts or ands. It is drawn to meet specific conditions and will fulfill the guarantee to a dot or 'twon't. If it doesn't, back it comes to us and back your cash goes to you without wail or murmur. An interesting tale of the Gear Shaper comes on request.

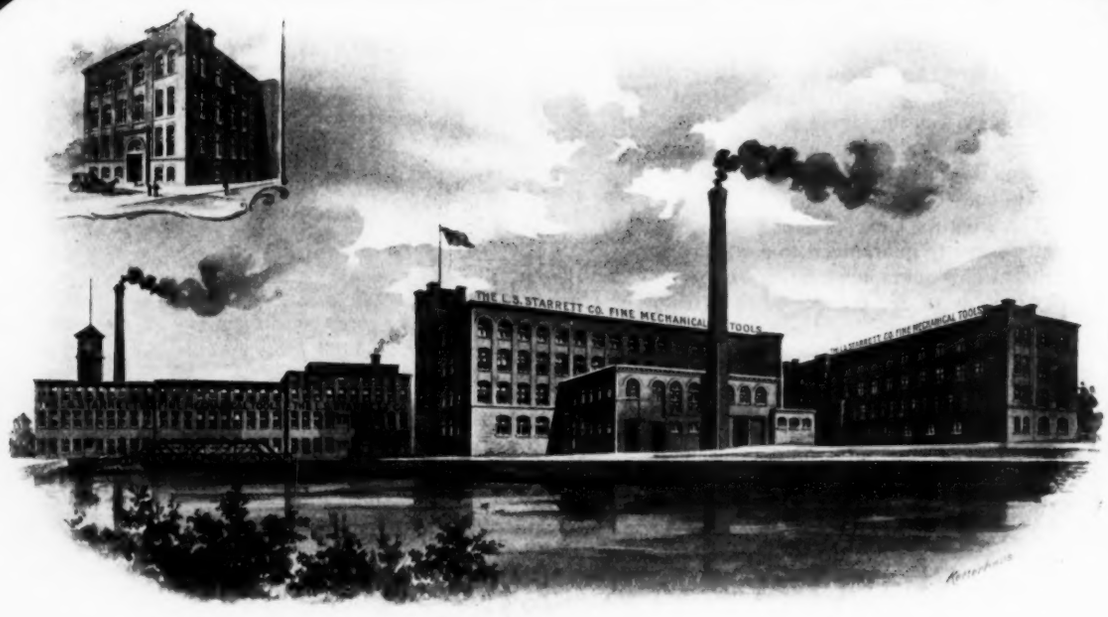


The Fellows Gear Shaper Co.,

Springfield, Vt., U.S.A.

AGENTS—Walter H. Foster, New York. Hill, Clarke & Co., Boston and Chicago. S. M. York Machinery Co., Cleveland, O. Brown & Zortman Machinery Co., Pittsburg, Pa.
FOREIGN AGENTS—Henry Kelley & Co., Manchester, England. M. Koyemann, Dusseldorf, Germany. Ph. Bonvillain, Paris, France. White, Child & Beney, Vienna, Austria.

TRADE MARK



Factories of **THE L. S. STARRETT CO.,** ATHOL, MASS., U.S.A.

The largest plant in the world devoted exclusively to the manufacture of Small Tools for Mechanics.

New York Store:
123 Liberty Street.

Chicago Store:
15 South Canal Street.

American Machinist

THE L. S. STARRETT COMPANY

MECHANICAL TOOLS

ATHOL, MASS., U.S.A.

Screw Pitch Gauge

Adjustable Jaw Cut-Nipper

Center Gauges

Thickness Gauge

Depth Gauges

Patent Six Inch Micrometer

High Speed Indicator

Adjustable Caliper Gauge

Micrometer

Hack Saws

Steel Measuring Tapes

Lock-Joint Inside Calipers

Lock-Joint Outside Calipers

Steel Rules

Outside and Inside Calipers

Combination Bevel

Try Squares

Cross-Test Level and Plumb

Micrometer Surface Gauge

Adjustable Bench Levels

Improved T Square

Micrometer Gauge

Bevel Protractor

Little Giant Jack Screws

Combination Squares

A Representative Group Of Starrett Fine Tools—

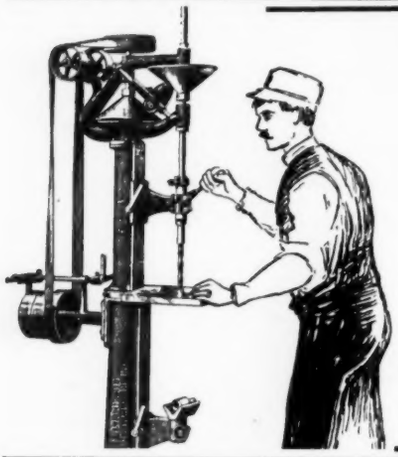
Just one or two from each of a few leading lines, but not enough to convey any adequate idea of our line as a whole. You should have a copy of

Our Catalogue No. 16 "C,"

because it will help you to choose the best tool for each part of your work, which will increase your efficiency and, sooner or later, your income. May we send you a copy?

The L. S. Starrett Company

ATHOL, MASS., U.S.A.



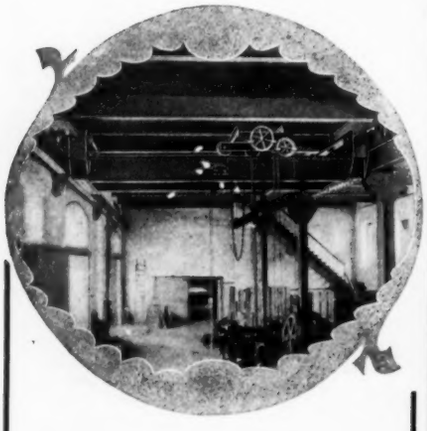
Two Cones And A Friction Roller

That's the simple, perfect, patented speed changing mechanism in Knecht Friction Drill Press. Move friction roller and you get any imaginable speed instantly while the machine is in operation. You can use ¾ drill, but machine is built for drills 9-16 inch and under. Satisfied users all over this country and the continent have sent duplicate orders You want a booklet or a machine? See our confidence below.

THIRTY DAYS ON TRIAL FREE. We will send one 13" drill, square table, round table, cup center, center point, V block with stem, V block with base, stop collar, endless belt all complete. If you decide to keep the machine you owe us $75.00, otherwise return the machine.

THE KNECHT BROTHERS COMPANY,

C. H. & D. R. R. and Knox St., Cincinnati, O., U.S.A.



THROUGH the choice of suitable materials, in connection with the greatest possible care in construction

MARIS CRANES

have been highly successful under very severe conditions imposed upon them, on account of ease of operation—small space required for head room—high efficiency secured from the use of direct spur gearing and because

THE MARIS CRANE is operated by one man from the floor.

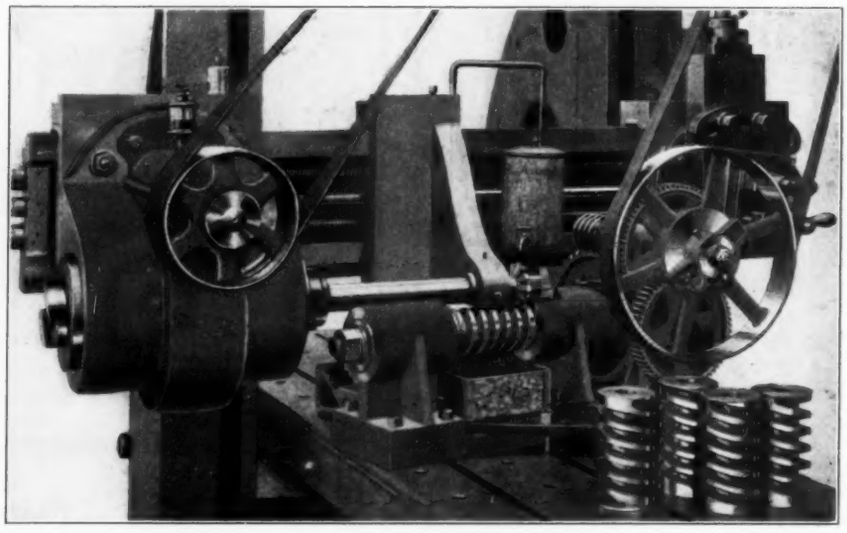
SEND FOR PARTICULARS.

MARIS BROS.

PHILADELPHIA.

AGENTS—Manning, Maxwell & Moore, New York, Pittsburg, Chicago, Cleveland, Boston.

The Farwell Miller at Work.



We are now cutting these steel worms, as shown above, on our planer with the help of the Farwell Miller and a little rig made for the purpose.

We have cut them on a lathe at three times the cost of the above method.

In this way we cut enough worms in a few days to last us several months. A special machine to do this would cost us $800 and be idle most of the time.

We use the Miller on many other kinds of work and on vertical, horizontal and angular spindle work.

We build this Miller in three sizes and can fit any planer.

We take care of the table feed, too.

We shall be glad to send you copy of our catalog No. 55, which fully describes this machine.

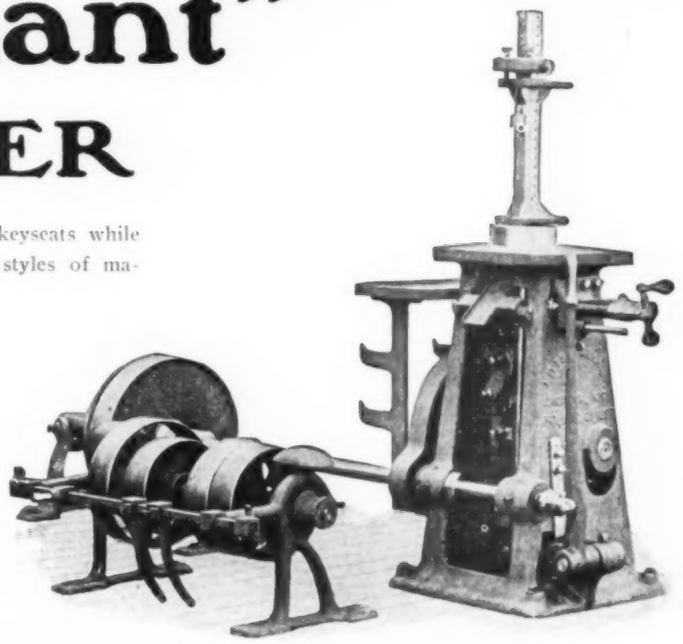
The Adams Company,

Dubuque, Iowa, U.S.A.

The "Giant" KEYSEATER

is a two-to-one tool—actually finishes two ordinary keyseats while one piece is being fastened for keyseating on other styles of machines Accurate keyseats, mind you.

And that's no idle boast, as "Giant" users will testify. Seven sizes, covering every keyseating requirement, from the smallest and simplest to the heaviest and hardest of work, and never anything but a perfectly true, straight keyway. Our catalog "M" and partial list of recent purchasers ought to interest you if you do keyseating.



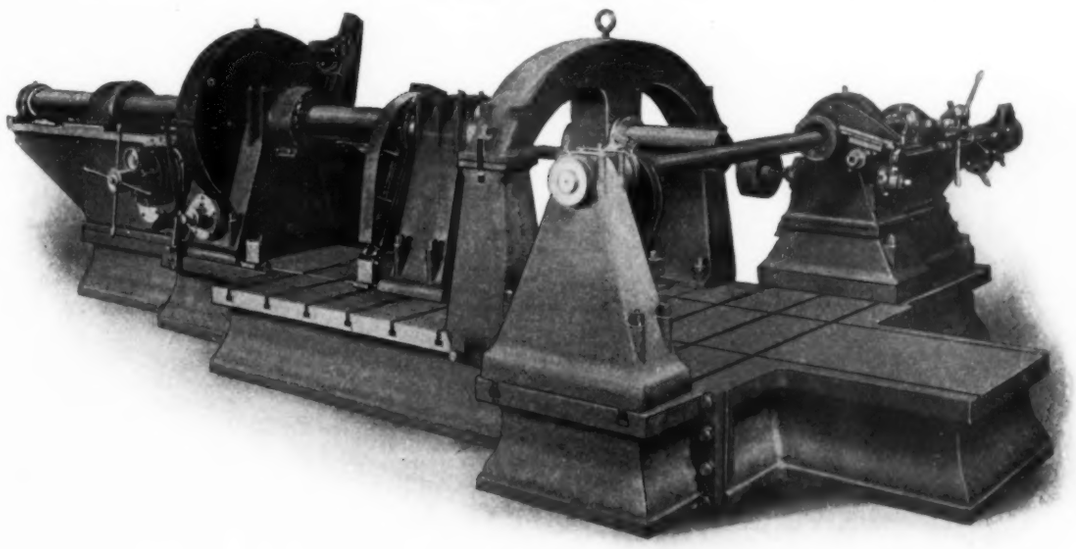
THIS IS No. 2 "GIANT" KEYSEATER WITH COUNTERSHAFT.

Mitts & Merrill, 913 Tilden Street, **Saginaw, Mich., U.S.A.**

AGENTS: C. W. Burton, Griffiths & Co., London. Julius G. Neville & Co., Milan, Italy.

For The Past Fifteen Years

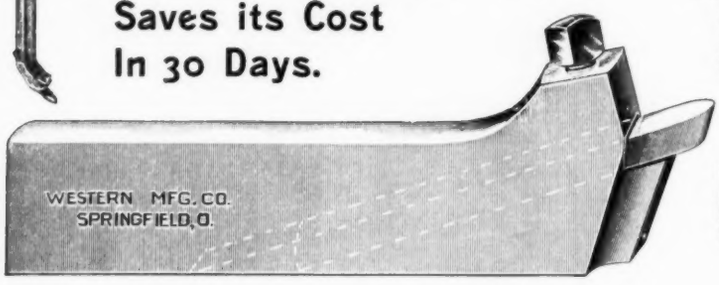
We've been making Horizontal Cylinder Boring Machines—not the same design all that time of course—but steadily improving high grade tools, until we have something now to boast of.



The details—sizes, weights, capacities, etc , are all in our catalog, of which we will gladly send you a copy.

Meadville Vise Co., Meadville, Pa., U. S. A.

Here's a Tool Holder That Saves its Cost In 30 Days.



It's the "Champion."

That support you see on its under side is there to prevent chattering and enable the operator to do good work without losing time. No tool holder made has such large cutters—every cut counts. Tempering and forging are forever done away with and the points of the cutters can be quickly and easily ground to any desired shape or clearance. Works either right or left hand—no side projections. You can work in mighty close corners with it. Once used you'll use no other. Catalog describes all its good features; shows our other good holders and an Expanding Mandrel that's all right. It's ready to mail.

The Western Mfg. Co.,
SPRINGFIELD, OHIO.

Watch The Leaks! A Small One Will Sink a Ship Or Wreck a Shop.

Rogers' Method

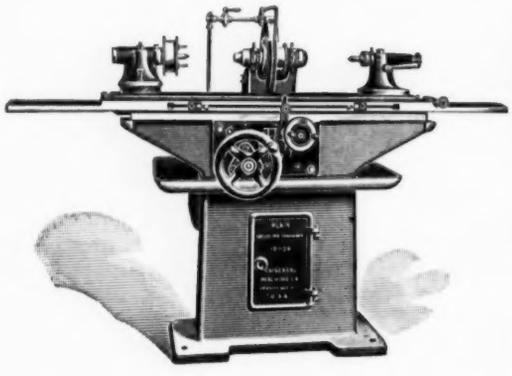
is a finger on the pulse of your business. It enables you to know in ten minutes just what a piece of work costs you and just what you made or lost on it.

This system is simple and suitable to any business. An office girl can run it and it is not bound and bedecked with "red tape." It shows exactly on what job the time was spent and where your stock of raw material goes. It shows whether the waste is due to careless work, faulty tools or a false economy in the purchasing department. It tells whether you can buy tools cheaper than you can make them and where expert labor is employed on boys' work. It puts every detail of the business before the manager whether he be in the shop twelve hours a day or traveling five hundred miles away. It's a stop to all waste and a means of figuring accurately on all work offered. Send 10c. for "An Industrial Problem."

Rogers' Universal Cost System, Keene, N. H., U.S.A.

Iroquois Machine Co.

MANUFACTURE UNDER PATENTS



Improved Universal, Plain, Disc, Face, Surface

GRINDING MACHINES,

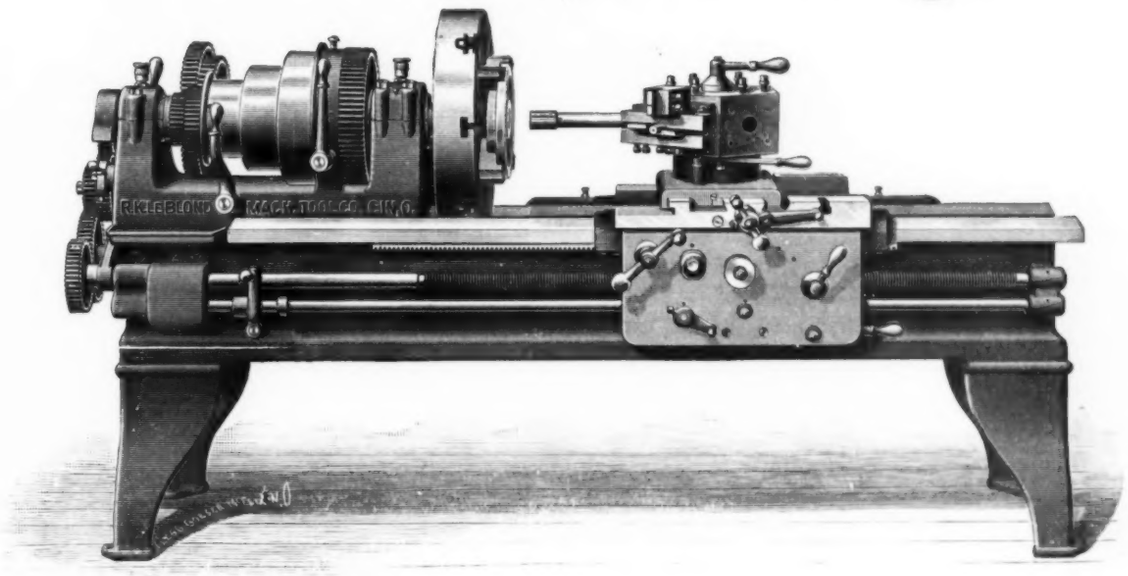
Wire Drawing Machinery,

Swaging Machines,

Roller Bearings.

Office 150 Nassau Street, NEW YORK, U.S.A.

A Work-Producing Money-Making Tool.



Special Turret Lathe.

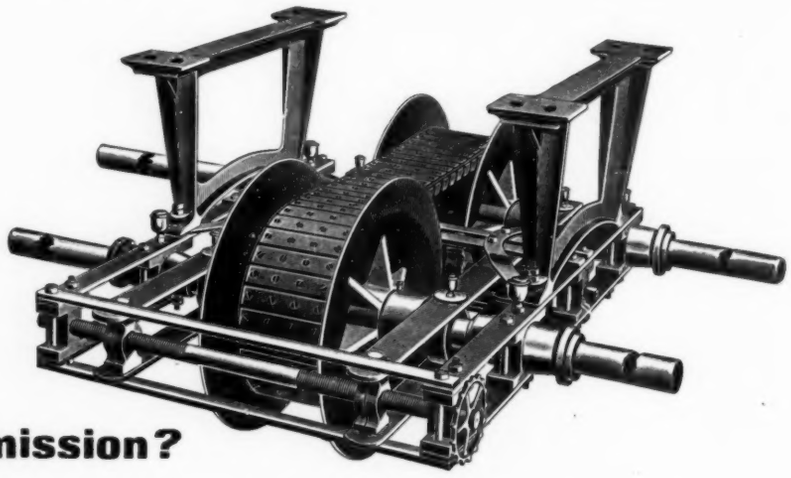
Made in 17, 21, 25 and 31 Inch Swing.

These Lathes are handled as easily as an Engine Lathe, and will produce from three to six times as much work. They are quicker to set up, quicker to handle and will place more finished parts on the floor in a day than the cumbersome, unhandy Chucking Lathes. The following are a few of the many valuable features: Friction Head, Double Friction Back Gears, giving six changes of speed without shifting a belt, which changes can be made instantly. With cone pulley eighteen changes are obtained. The turret has a double bearing on slide, and is gibbed at right angles to the line of strain, something new in lathes of this description. All wear can be taken up in the turret and slide. Large sizes are triple geared. Locking pin and ring are tool steel, hardened and ground; rack pinion supported on both sides of rack; four quick feed changes—these changes can be varied by change gears to suit any class of work. Besides this, we have the lead screw for accurate chasing and tapping. Send for further particulars.

The R. K. LeBlond Machine Tool Co.

4609-4621 Eastern Avenue, Cincinnati, O.

O Bother The Cone Pulley!



One step gives too high a speed and the next one too slow. What's a poor man to do unless he puts in

The Reeves Variable Speed Transmission?

It's easy enough then to get the exact speed you want, to get it quick and without stopping the wheels to do it. The right speed for the work means the right results at the right time and "a sight of calkerlation" saved in the operation. *The Reeves Transmission* is different from some of the new things, because it's strong enough to stand the work. The great fault of most of these things is that they give out and slip and do all kinds of uncomfortable things at inconvenient times, but every detail of this one is built—not "like a watch," but like a good machine tool, and it is a fitting companion to any high-grade tool. Send for the catalog and see how suited to your needs this apparatus is.

ENGLISH AGENTS—Chas. Churchill & Co., 9 to 15 Leonard Street, Finsbury, E. C., London, Eng.; Birmingham, 2 to 10 Albert Street; Glasgow, 52 Bothwell Street; Manchester, 2 Charlotte Street, Moslet Street; Newcastle-on-Tyne, Albion Building, St. James Street.

Reeves Pulley Company,

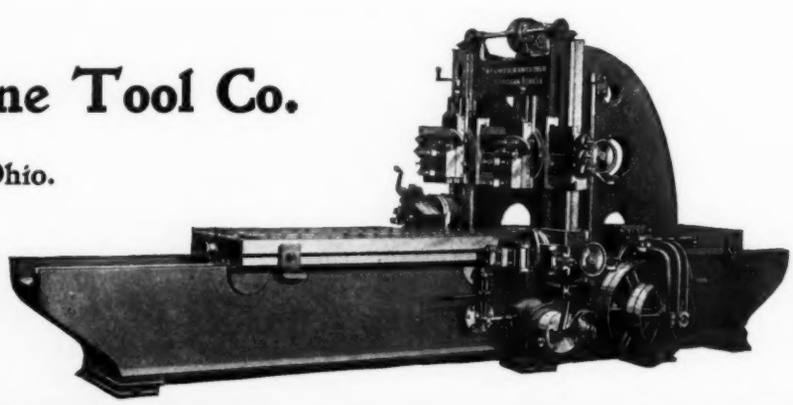
COLUMBUS, IND., U. S. A.

The Belmer Planer.

The Planer built with extra deep and heavy housings for extra deep and heavy work. The Planer that has an unusually heavy table—one that bears the burden without a sign of give or strain. The Planer with high cutting speeds and quick return. The Planer that has taken heavy planer work, heretofore unprofitable, and made it profitable by rapid and accurate handling. The Planer built with two, three or four heads and in sizes, 30" and upward. The Planer that took a medal at the Pan-American. The Planer which is fully and interestingly described in the Belmer Planer Catalog which we will be pleased to send you.

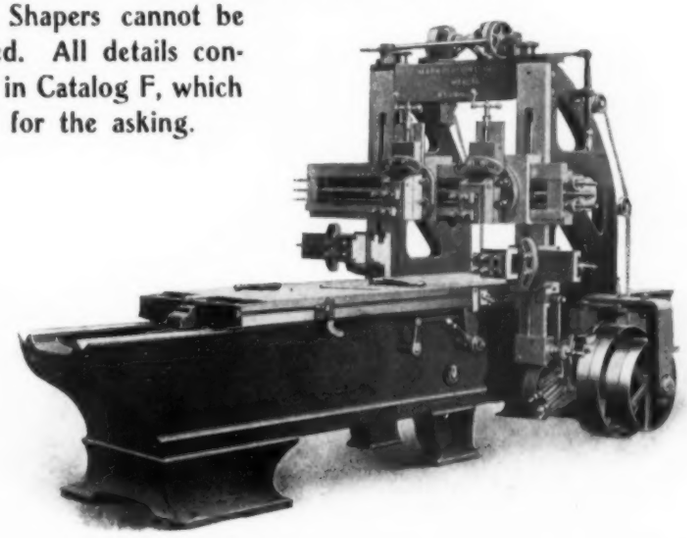
Belmer Machine Tool Co.

Cincinnati, Ohio.



Flather Planers

Are not average planers. They are planers of rare merit and have acknowledged reputation as being heavy earners of planer dividends. They are the result of years of painstaking effort intelligently directed. Can furnish in any size from 22 inches to 54 inches. And our line of Crank Shapers cannot be excelled. All details contained in Catalog F, which comes for the asking.

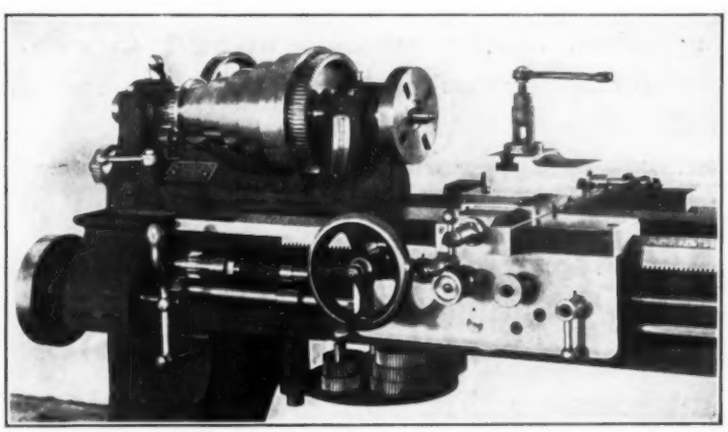


The Mark Flather Planer Company,

Nashua, N. H., U.S.A.

The Lathes Built By Flather

are remarkable lathes; remarkable in design, in the choice of material used, in the workmanship going to shape this material into the finished tool. Among the features of the **New Model Flather** are: The displacing of the cone feed by a plain pulley, so that the simple movement of a lever affords different changes of feed; has variation of from 3/8" to one turn of spindle to 500 turns per inch, cutting from 4 to 72 threads per inch; these lathes are strong, they handle work in that sturdy way that brings results—results which carry larger gains and full satisfaction; **Flather Lathes** have a careful distribution of metal to any and all points of possible strain; they are not clumsy in appearance in any way. **Flather Lathe** merit is of no immediate growth; it is the result of years of experience in the building of such tools, backed by intelligence and a determination to build well. We make these lathes from 13" to 30" swing and are pleased to have your lathe inquiries.



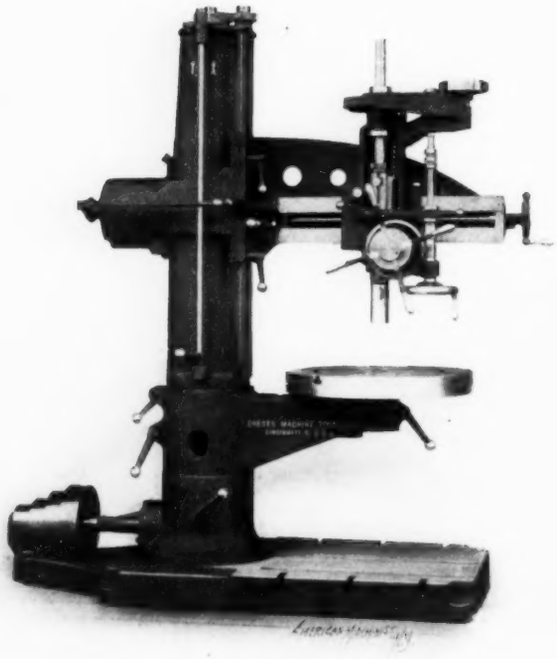
Flather & Co.,

Nashua, N. H., U.S.A.

AGENTS—Hill, Clarke & Co., Boston, New York and Chicago. Adolphe Janssens, Paris and Brussels. Chas. Churchill & Co., London. V. Lowener, Copenhagen. Hans Richter, Berlin. Landre & Glinderman, Amsterdam.

Watch Our Improved

Radial Drills



36-inch Radial.

This is one of them now ready for the market after a thorough trial in our works.

The **"One Lever"** so well known on our machines, which starts, stops, engages the back gears and reverses the spindle quickly for tapping, has been maintained, but an **auxiliary lever** has been provided for to avoid stopping the machine when it is set for tapping. This lever can also be used for tapping when it is desired (for small tapping) to run the tap forward and only at a **slightly increased speed** backward.

The much appreciated device for preventing taps from breaking when they strike the bottom of the hole or any other obstruction is also maintained.

The number of feed changes have been doubled and the feed can be varied by shifting the knob on the feed rod while drilling.

The spindle is provided with a **depth gauge** and **automatic stop.**

Either of the four levers on the **quick return** disengages the feed and operates the spindle. All vital parts have been strengthened and many other improvements embodied, too numerous to mention.

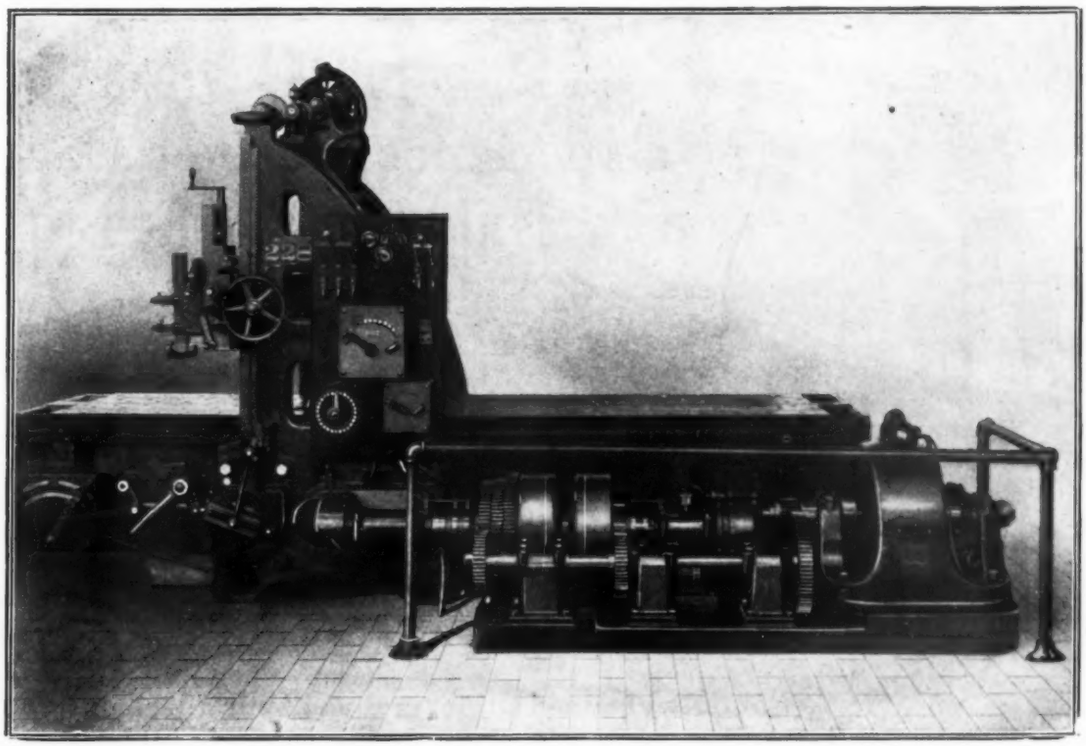
We are also prepared to furnish a **variable speed countershaft** at a small additional cost, by which a **speed curve,** from the slowest to the fastest speed, without intersections can be obtained and also a full revolution of the arm procured.

Dreses Machine Tool Co.,

Cincinnati, Ohio, U.S.A.

AGENTS—Manning, Maxwell & Moore, New York, Boston and Chicago; Carey Mchy. & Supply Co., Baltimore; Prentiss T. & S. Co., Pittsburg; Wm. C. Johnson & Sons Mchy. Co., St. Louis; Pacific Tool & Supply Co., San Francisco and Hawaiian Islands; Selig, Sonnenthal & Co., London; C. Schinz, St. Petersburg; E. Sonnenthal, Jr., Berlin; G. Koeppen & Co., Moscow; V. Lowener, Copenhagen and Stockholm; Van Rietschoten & Houwens, Rotterdam; Wilh. Sonnesson & Co., Malmo, Sweden; Stussi & Zweifel, Milan Italy.

Magnetic Clutches.



The use of modern tool steels with high cutting and return speeds, together with the rapid acceleration of the table demanded by modern practice, have increased to such a degree the wear and tear on the driving belts of planers that the introduction of some other form of drive is rapidly becoming a necessity.

Our Magnetic Clutch Drives meet all of the requirements for this service. We have in successful operation magnetic clutches applied to tools varying in size from an eight foot planer to a twenty-four inch shaper.

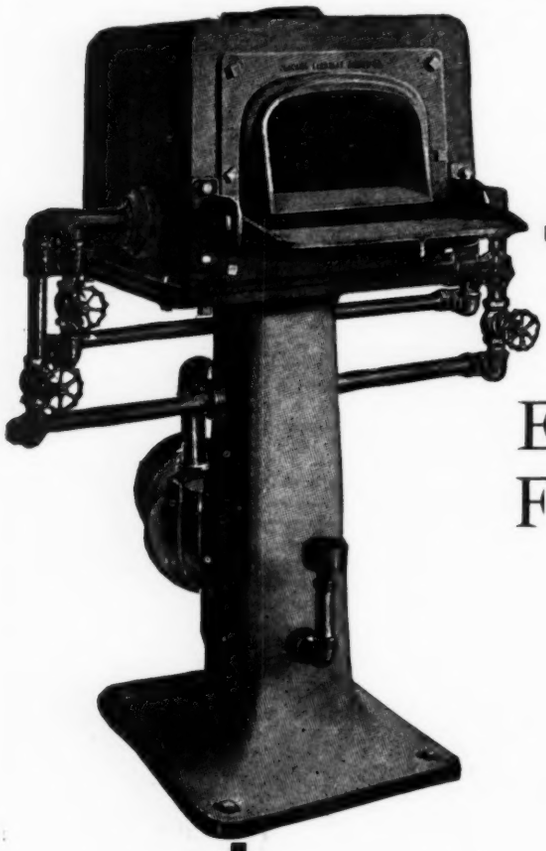
If interested, write us your requirements and we will be pleased to furnish estimates.

The

Electric Controller & Supply Co.

Consulting Electrical Engineers
and Manufacturers.

Central and Giddings,
Cleveland, O., U.S.A.



Experience Doesn't Count For Half As Much

in tool hardening as it used to. Most everybody who does this work knows what the proper temperatures are for different kinds of work. and these temperatures can be obtained with an absolute certainty with the

STEWART GAS BLAST FURNACE

Not only obtained but maintained hour after hour, as long as the job lasts. No more "bad lots" which the best men have with the coal or coke forge. No more accidents that always occur at critical and costly moments, but the hardening and annealing of steel put on an absolutely scientific basis. It's worth $85.00 to you to have one of these, isn't it? Let us send you one on trial. You needn't keep it a day if you don't like it, but we fancy you will be glad to exchange a check for it after you've tried it once. Why, the cleanliness of it alone is worth the price—no coal dust, no smoke, nothing but a couple of valves and the gas pipe. Think over our offer, but you'll lose money if you think too long without doing something. Get the book at once, anyhow.

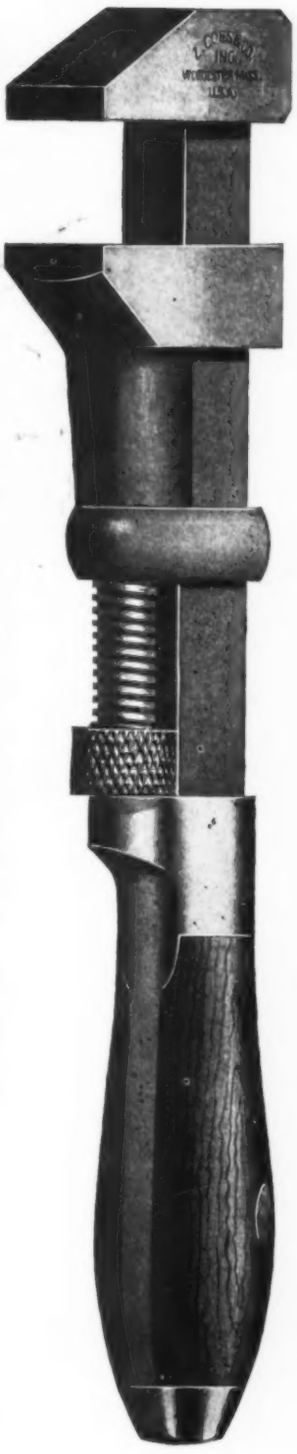
Chicago Flexible Shaft Co.,

124 La Salle Ave., Chicago, U.S.A.

European Agents: Niles Tool Works Co., London, England. Fenwick Freres & Co., Paris, France; Agents for France, Italy, Belgium, Spain, Portugal and Switzerland.

Gentlemen, There Is Just One Genuine "Knife-Handle" Wrench And Coes Makes It.

Trade Mark



Like every other good thing, this wrench is imitated, even to the actual appropriation of our registered trade-mark; and like most other imitations, those of the Coes "Knife-Handle" Wrench are gotten out with the single purpose to separate people from their money under the impression that they're buying the "real thing." They imitate everything but the QUALITY; why not that? There isn't a weak spot as big as a pin head in any genuine "Knife-Handle" Wrench—no "tinkered" jaw castings, no "faked" or "sandwiched" wood handles, no freak screws or fool features of any sort. The Coes "Knife-Handle" Wrench is built and sold on honor, and is no copy. Made of the best steel and other materials, and put together under tension. Wood handle is securely fastened at BOTH ends, and will not split off the first time you hit it. The Coes "Knife-Handle" stands for all that is best in wrench making. You should see that you are not imposed upon by one of the "just as good" kinds that are being sold under the same name. We're going after these infringers and mean to make it uncomfortably warm for them. Of course, the dealers who sell these infringing wrenches are equally liable with the manufacturers. Meantime, ask for the genuine "Knife-Handle" and see that the name of Coes is there to guarantee its quality. Patent registered since April 9, 1895.

Ask for our Wrench Literature.

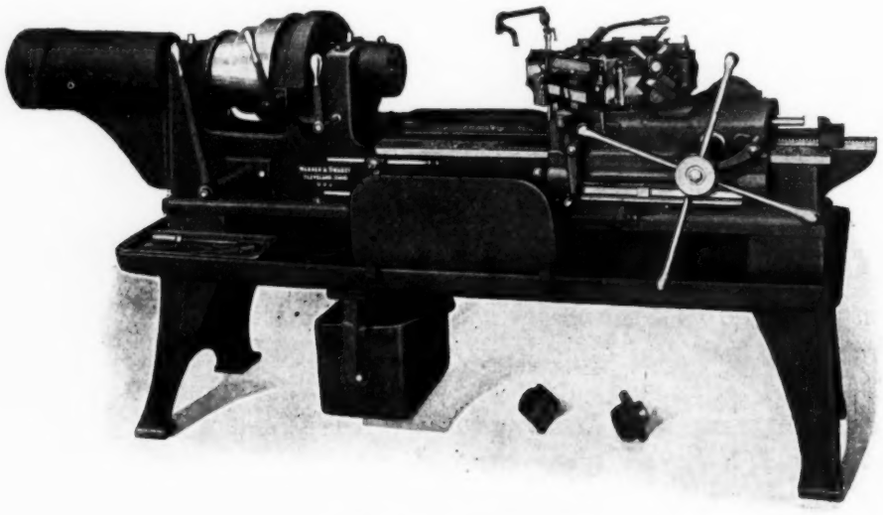
Coes Wrench Company,

Worcester, Mass.

NEW YORK AGENTS:

J. C. McCarty & Co., 10 Warren St.
J. H. Graham & Co., 113 Chambers St.

The Hollow Hexagon Turret Lathe



. . . SPECIAL FEATURES . . .

Automatic Chuck and Roller Feed. Hexagon Turret. Independent Adjustable Stops. Supplementary Stops for turret slide. Geared feeds—positive—changeable instantly—no feed belts.

Capacity—2 inches in diameter, 24 inches long. Complete set of tools for general work furnished with each machine.

Let us send you the "HOLLOW HEXAGON TURRET LATHE BOOK." It tells the whole story.

Complete line of Screw Machines, Turret Lathes and Brass Working Machinery. Catalog?

The Warner & Swasey Co.,
Cleveland, Ohio, U. S. A.

EUROPEAN AGENTS—Chas. Churchill & Co., London, Birmingham, Manchester and Glasgow. Schuchardt & Schutte, Berlin, Vienna, Brussels, Stockholm, Cologne and St. Petersburg. Adolphe Janssens, Paris, France.

A Word About Milling Machines

We make Milling Machines, Plain and Universal, with belt-feed and all-gear quick change feed.

Our machines embody original features, are heavy, accurate and convenient. Cone pulleys are of liberal dimensions, which gives you great spindle power so essential for fast working. The feed gives you all power the belt on the spindle can pull with back gear engaged. Examine the universal dividing head and tail-stock and judge for yourself if they are not an improvement. The tail-stock is adjusted by means of rack and worm; when once set it cannot fool you as it can when only held by friction. The crank to move the worm is directly on the worm shaft, and therefore has not the play of those that have gears interposed between them.

Our new All-Gear Feed Cut is in the hands of the engraver and in a short time we will have a new catalog out, which we will be pleased to send on application.

We also make a Universal Cutter and Tool Grinder which is a model of its kind. Send us your inquiries.

The Oesterlein Machine Company,

AGENTS—Fairbanks Co., New York, Buffalo. Girard Machine & Tool Co., Philadelphia. J. H. Dawson Machinery Co., Chicago. Smith-Courtney Co., Richmond, Va. Thornton Machinery & Supply Co., Providence, R. I. National Supply Co., Toledo. Milwaukee Rice Machinery Co., Milwaukee. Bailey-Lebby Co., Charleston, S. C.

Beard and Elam Sts.,
CINCINNATI, OHIO.

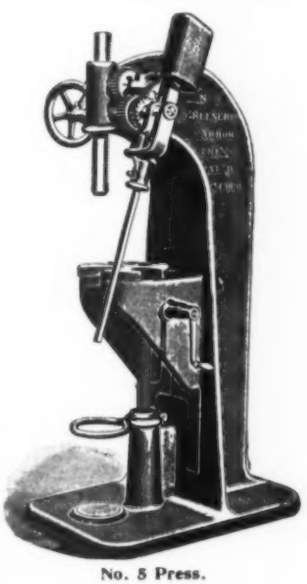
It Would Do You a Heap of Good To Go Around

No. 3 Press on Lathe.

and visit some of the best managed machine shops just to see how extensively the **Greenerd Arbor Press** is used.

Ask the workmen how they like them. Ask the superintendent the same question. Possibly they will all give different reasons why they like the **Greenerd Arbor Press.**

One man will tell you that things were so crowded in the shop that there was not room for the ordinary pounding block, and he put in a **Greenerd Arbor Press** to save shop-room. Another man will tell you that it is a great saving of time. Still another will say that when the **Greenerd Arbor Press** is used he is sure that the centers of the arbors will be kept clean, which is not the case when using a babbitt mall, or a piece of soft metal to protect the arbor. Someone else will tell you that it saves the finished work. The workmen will tell you that it is easier to press an arbor in with a **Greenerd Arbor Press** than it is to drive it with a hammer.

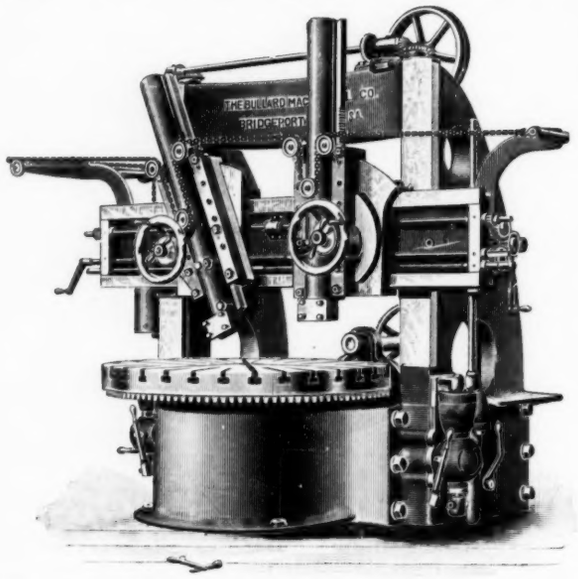


No. 5 Press.

The reasons these men will give are good and sufficient, and if you will go far enough you will return to your own shop ready to send us an order for one of these presses on trial.

EDWIN E. BARTLETT, 362 Atlantic Avenue, Boston, U. S. A.

No Need of Shopping Or Running 'Round



If you want good machine tools, want to see them before ordering and want to see them running by electricity, we can give you anything you want. Our warerooms contain the goods of about a score of the leading manufacturers whose factories are scattered over a few thousand miles of railroads. Instead of spending two or three weeks visiting these places you can do just as well in a few hours with us. Prices are the same as though you bought direct. Deliveries are as prompt and often more so, and every facility is afforded for comparing different makes and getting what you want. Here are some of the companies we represent in this territory :

The Bullard Machine Tool Co.,
The Cincinnati Milling Machine Co.,
The Lodge & Shipley Machine Tool Co.,
The Bickford Drill & Tool Co.,
The Cincinnati Planer Co.,
The Cincinnati Machine Tool Co.,
The Binsse Machine Co.,
The Landis Tool Co.,
Messrs. Gould & Eberhardt,
Baker Brothers,
Jas. Clark, Jr., & Co.,
The L. W. Pond Mach. Co.,
The Ferracute Machine Co.,
The Whitney Manufacturing Co.,
The American Engineering Works,
The National Machinery Co.

We are just moving into these new warerooms of ours. They are very commodious and among the finest. They are on the ground floor for a novelty and just a block from the Union Station. You can run around between trains if necessary. Come and see us or write us a letter about it.

Marshall & Huschart Machinery Co., 24-26 Lake Street, Cleveland, Ohio.

It Doesn't Take Long For a Cross Oil Filter To Prove Its Worth.

Here's more evidence from a firm who pinned their faith to the Cross and the pin is still there. Read their letter :

CLEVELAND, OHIO, U.S.A.
Sept. 10th, 1902.

The Burt Mfg. Company,
Akron, Ohio.

Gentlemen—In reference to yours of 8th inst., beg to advise you that the Oil Filter which you furnished us has been in operation for several months. Its operation is perfectly satisfactory. We waste no oil except that which is unavoidably lost by splashing.

Yours truly,
A. C. EASTWOOD, Chief Elect.
THE WELLMAN-SEAVER-MORGAN ENGINEERING CO.

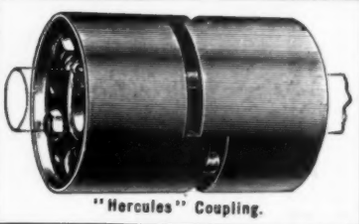
We continue our offer to send a Cross Oil Filter on 30 days' trial, free of expense to the user. We don't know of any better way of showing our faith in our Filter and proving our claims for it

A trial is all we ask, and if the Cross doesn't cut your oil bills squarely in the middle, send it back at our expense. Twelve sizes are shown in our free catalog, and you can try any one of the twelve. Write for catalog.

The Burt Manufacturing Co.,
255 Main St., AKRON, O., U.S.A.
...Largest Manufacturers of Oil Filters in the World...
A complete stock of our Filters is carried by Shelby & Co., London, E. C., Sole Agents for Great Britain.

If You Have any Trouble In Coupling Shafts

you're not coupling them in the right way. There's a Patent Compression Coupling stamped "Shaw's" that couples shafts without even the bother of centering them. Sometimes shafts vary a little in diameter, but with this coupling that doesn't matter at all.

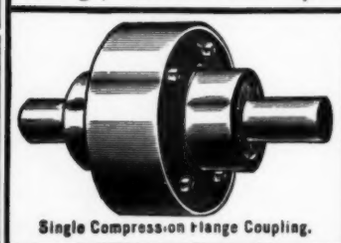


"Hercules" Coupling.

If a shaft gets out of alignment it shows at once. The time which you would ordinarily spend in cutting down shafts and key-seating them you can now spend more profitably by using

Shaw's Patent Compression Clutch Shell Coupling

There's only one way to assemble a Shaw Coupling—so you can't go wrong. Four styles: Single and Double Flange, "Hercules" and "Ajax." There's some good food for thought in our circular. For sale by the leading dealers everywhere.

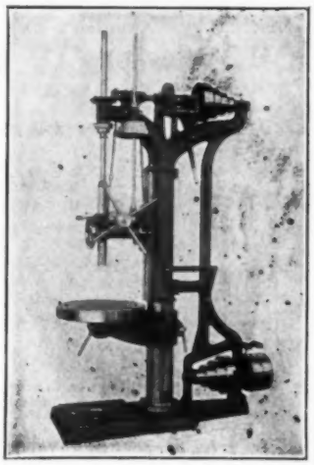


Single Compression Flange Coupling.

Patterson, Gottfried & Hunter, Ltd.,
146-150 Centre St., New York.

You Can't Go Wrong

in buying an Aurora Drill—that's sure. No upright drill, size for size, will do more or better work than an Aurora, and there's a lot of pretty good drills that are not to be compared with it on a basis of results. We make these "Aurora Uprights" in all sizes from 12 to 50 inch swing, and fit them with every drill device that develops profits—put on motors if you want them. We'd like to send you our Catalog No. 7, showing our entire line, and the names of some good people who have been using them long enough to know all about them. We build a mighty good Plain Miller, too—two sizes. Yes, and Boiler Drills.



AURORA TOOL WORKS, AURORA, INDIANA.

Why Use Rigid Couplings

For connecting motors direct to shafts of different machines? This Insulated Flexible Coupling of Cresson's overcomes every difficulty heretofore experienced by electricians in couplings of the rigid style. It has been thoroughly tested up to 2000 H.P. and has given every satisfaction.
No coupling made shows better material. In finish no room is left for criticism. We shall be pleased to furnish any information or quote prices. In inquiring state details as to horse power, speed, diameter of motor and machine shafts, also general conditions under which machinery is operated. Our reply ought to prove of mutual advantage.

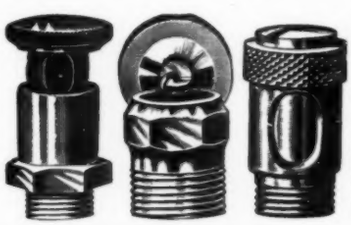
PATENTED

GEORGE V. CRESSON COMPANY,

Main Office and Works:
Allegheny Ave., West of 17th St., Philadelphia, Pa.

141 Liberty Street, New York.

BOWEN——BOWEN——BOWEN——BOWEN——BOWEN——BOWEN——BOWEN



Bowen Oil Cups

are for all kinds of oil cup service. They are all good and all shown in book.

Bowen Mfg. Co., Canal Street, AUBURN, N.Y.

Agents for Great Britain, Germany and France—Seilig, Sonnenthal & Co., 85 Queen Victoria St., London, England.
Switzerland Agent—J. Lambercier, Geneva.

BOWEN——BOWEN——BOWEN——BOWEN——BOWEN——BOWEN——BOWEN

Extra Heavy Rough Brass Unions

And BRASS CASTINGS For All Purposes.

Phosphor Bronze for Machine Box Bearings, Etc.
Special Finished Brass Work to Order.

NOLTE BRASS CO., P. O. Box 583, SPRINGFIELD, O.

It is New and Good.

Go into the shop and have a man center a piece three feet long, and see how much over one minute you are losing every time a piece is centered, and save money by ordering one of our Centering Machines. Takes in from ⅛ to 4 inches. By clamping in Vise a Disc with stem, it makes a serviceable traverse drill, or a drilling knee can be furnished at small expense. Extra fine counters for sale also.

PHOENIX MFG. CO.
32 Union Place,
Hartford, Conn.

Next to the Forge

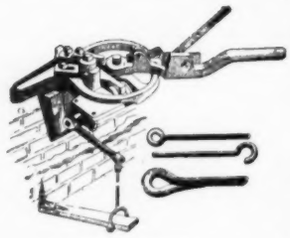
is the spot for this All-Metal Rack. It's a blacksmith's helper that all but hands you the tools you need when you need them. No hunting for lost tools, losing time and money. When through using your fullers, flatters, tongs, etc., hang 'em on the rod around the edge. Put your small tools, etc., on the upper tray—your work on the under one. Drawer goes with it when wanted, for keeping small tools locked up. Built with two or three trays and with ball-bearing casters or feet as desired. Our free Tool Rack Book tells all about it.

And Here's Another

rack for the other side of the forge. It's our Pan Top Rack for holding work hot from the forge and small parts. No matter how hot—heat can't hurt it. Why not keep your smith shop tidy? Regular size 36″ high (easily varied) with trays 22 x 28 or 26 x 34, 4½ and 6 inches deep respectively. $9 25 for small size—$15 for large. Small size with casters, 75 cts. extra—large size, $1.00 extra.

Write for Book.

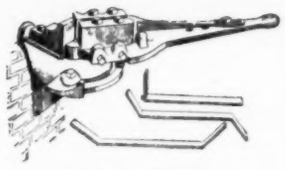
New Britain Machine Co.,
New Britain, Conn.



EYE BENDER.

Eye Bender.

For bending all kinds of eyes, hooks, etc., from heated stock. You certainly have some of these forms to bend occasionally, and if so you can save the cost of a bending tool on a few small jobs. **It's what you save that makes you rich.**



ANGLE BENDER.

Angle Bender.

Clean, square corners result from the use of this machine. Many light jobs can be bent cold. Its money-saving ability is especially evident in the ease and rapidity with which it can be set to take different sizes of stock and to bend angles of different degrees.

Full Directions Accompany Each Machine.

Both the Eye Bender and the Angle Bender are so arranged that they can be easily and quickly adjusted to suit the various sizes of stock. To change the size of eye, all you need to do is to remove the pin around which the stock is formed, and insert pin of the size required. The Angle Bender has removable die blocks to suit the different thicknesses of material and also a movable stop block and gauge.

These tools are easy and rapid in their operation. **Any blacksmith or helper can operate them.**

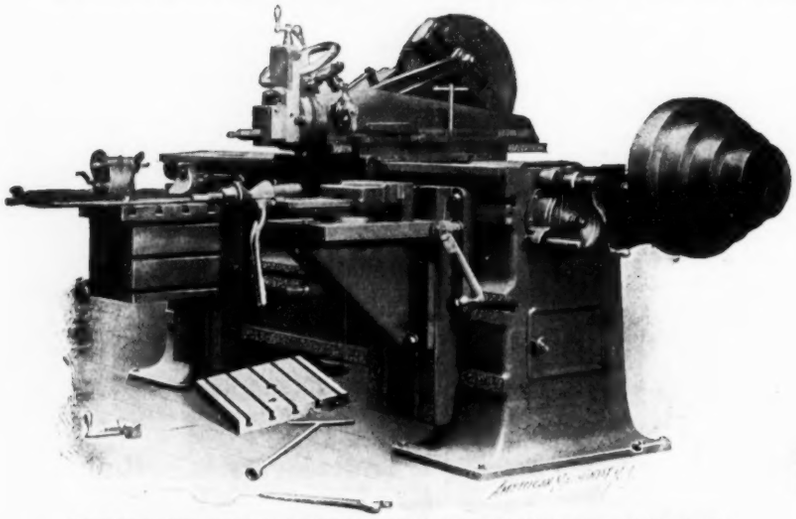
Both the Angle Bender and Eye Bender are secured removably to brackets which may be fastened to an anvil, forge frame, or any other location in the shop convenient to the operator.

If you are in doubt as to which of the different patterns of these tools is most suited to your needs, or if you have work which you think will require special machines or parts, send us drawings, blue prints, sketches or samples of the work you have to bend, with dimensions, and we will tell you definitely what we can do to meet your requirements.

Write for our catalog descriptive of these and other money-saving specialties.

Wallace Supply Company, 618 Garden City Block, Chicago, Ill.

"Cincinnati" Traverse Shapers, 16, 18, 20, 24 and 36 Inch,



EIGHTEEN-INCH SINGLE HEAD TRAVERSE SHAPER.

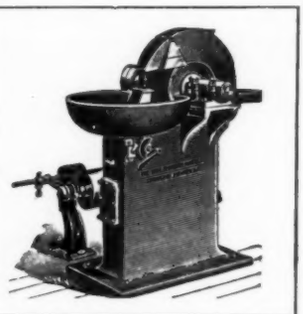
are the latest and highest development of this type of machine tool. They are rigid, accurate and powerful, and, stroke for stroke, are the heaviest by the scale. All feeds are operated from the head, or saddle, where most convenient to the workman.

The Cincinnati Shaper Co.,

Cincinnati, Ohio, U.S.A.

Does The Floor Around Your Grinder Look Like a Mud Puddle?

Is your grinder a breeder of wet feet and rheumatism? You can cut that out forever any time you're ready to put in a "Safety" Grinder. That bowl you see keeps the water inside the machine and prevents slopping. The simple lifting of a lever supplies all the water you need and applies it to the wheel. When necessary to draw water off you can do so through an outlet hole in back. The Grinder is just heavy enough to put vibration out of business. It has large spindles and long bearings, self-oiling and dust-proof. Wheel is always convenient, whether you stand in front or at side of machine. The hood has an opening in back—you can throw it up when you have any long boring bars or long handle cold chisels to grind. It's a mighty handy, well-made Grinder throughout and we'd like to send you the Catalog that gives every detail.



The Slopless Grinder, otherwise known as the "Safety."

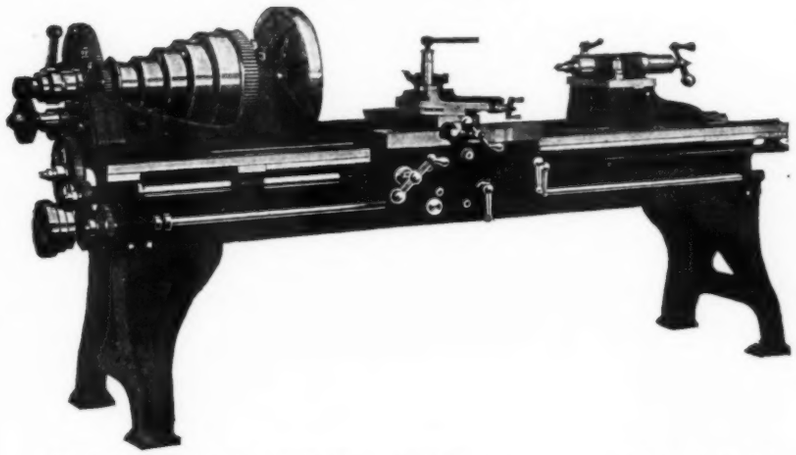
The Safety Emery Wheel Company,

SPRINGFIELD, OHIO.

Represented by Pfell & Co., London. De Fries & Co., Act.-Ges., Berlin, Dusseldorf. Adolphe Janssens, Paris, Brussels. V. Lowener, Copenhagen, Stockholm. Adler & Eisenschitz, Milan.

ENGINE LATHES.

15, 18, 22 and 32 in. swing.



These lathes are strong, well built tools, adapted to do the best work in the least possible time.

Our aim has been to have them simple in design and mechanical movements, thus insuring long life, accuracy and a habit of always being in order and ready for business.

They are not the cheapest tool in the sense of first cost, but if quality is any consideration we are in a position to give large measure for the dollars you invest in our tools.

The above cut represents our 18 in. x 8 ft. Lathe. As now built, however, it has cabinet legs, set-over tailstock and covers for the gears on headstock.

We also build Geared Shapers, 15, 22, 26, 30, 34 and 48 in. stroke. Elliptical Gear Crank Shapers, 16 and 18 in.

Shall be glad to send catalog to intending purchasers.

GEO. D. WALCOTT & SON, JACKSON, MICH., U.S.A.

Our Tools can be seen at the establishments of Buck & Hickman, London, England; Fenwick Freres & Co., Paris, France; McDowell, Stocker & Co., Chicago, Ill; Montgomery & Co., 105 Fulton Street, New York City; Strong, Carlisle & Hammond Co., Cleveland, Ohio.

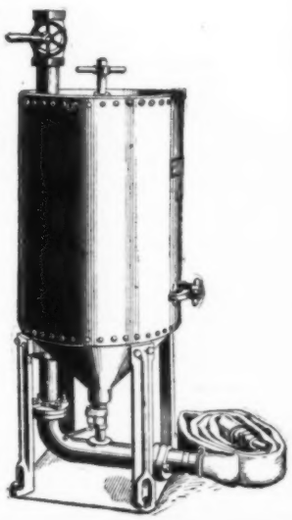
THE PAXSON-WARREN

SAND BLAST SYSTEM

PATENTED.

FOR **Cleaning Castings, Removing Paint and Scale from Metals, Frosting Metals, etc.**

Operated by compressed air at a pressure varying from 10 to 30 lbs. The **Exhaust System** used in connection with this device draws the dust from operating room to the washer where it passes through a spray of water and settles to bottom of washer as mud.



CORRESPONDENCE SOLICITED.

Our Foundry Supplies and Equipment are made by us.

ASK FOR CATALOG No. 11 A.

J. W. PAXSON CO.

PHILADELPHIA, PA., U. S. A.

Did You Ever Wear a Vici Kid Shoe ?

If so, you know that this light kid, tanned by the VICI process, is stronger than the heavy calf skin tanned by the old fashioned processes. At the same time it is water proof and stretches less. Now, in making the

Vici Leather Hydraulic Packings

We start with the heaviest procurable steer hide and by applying the VICI process of tannage we produce a leather many times stronger than can be produced by any other process. Then by superior machinery this leather is made into the various shapes and sizes. All this is in a neat little booklet, which can be yours for the asking.

E.F.Houghton&Co.

244 West Somerset Street, PHILADELPHIA.

174 Lake Street, CHICAGO.

Universal Hack Saw Blades.

WHEN you buy Hack Saw Blades why not get Hack Saw Blades of quality, blades that will be serviceable, long lived and satisfaction-giving in every way? In short, why not buy the "Universal?" These blades are as blades ought to be, tempered all the way thro', and are both hard and tough at once. Those who use them once come back for more. Shall we hear from you?

West Haven Mfg. Co.,
NEW HAVEN, CONN.
The Fairbanks Co., 78-80 City Road, London, E. C.

Every Shop Needs This

portable hydraulic press. It can be wheeled to its work and it is suited to a wide variety of uses, such as removing pins from crank discs, shafting from sheaves and similar work. It is built in different sizes and for different pressures; principally for 60 to 100 tons.

At the price we charge, it easily pays for itself in short order. Circular No. 21 is descriptive and free.

CHAS. F. ELMES ENGINEERING WORKS Estab. 1863
250-258 Fulton St., Chicago, Ill., U.S.A.

TEXT BOOKS BY PROF. C. H. BENJAMIN, M.E.
MACHINE DESIGN, 2ND EDITION $2.00
MECHANICAL LABORATORY PRACTICE 1.50
NOTES ON HEAT AND STEAM 1.00
PRINTED AND PUBLISHED BY
CHARLES H. HOLMES, 2303 EUCLID AVE.
CLEVELAND, OHIO

We Say

That the Star Saw represents more value in proportion to its cost than any other tool offered to the public.

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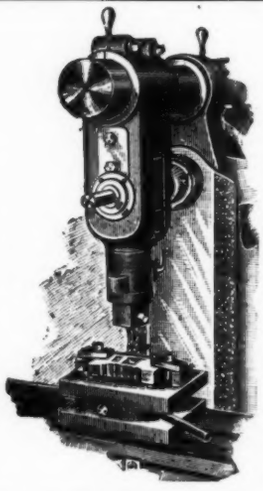

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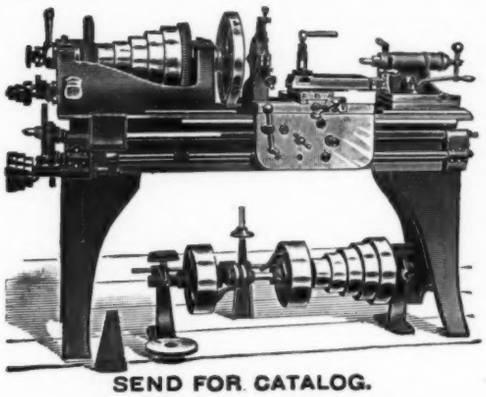

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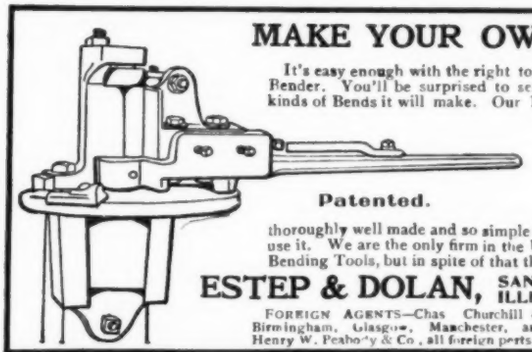

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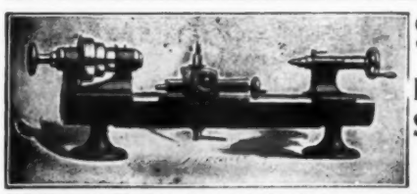

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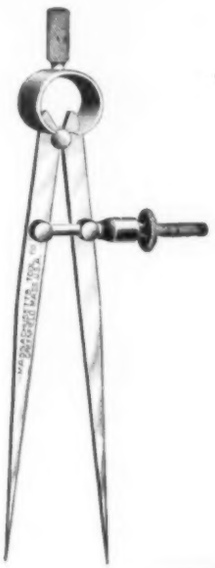

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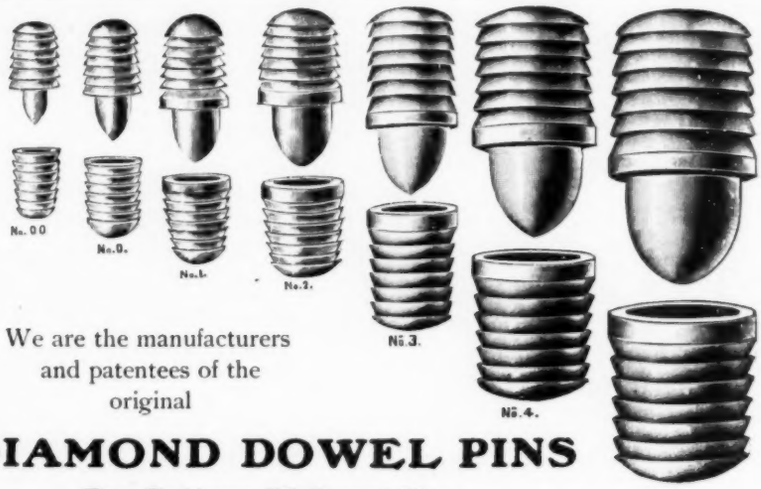

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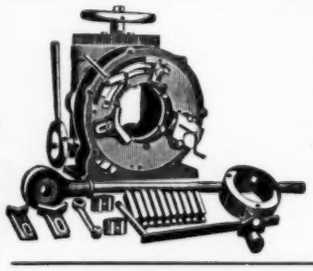

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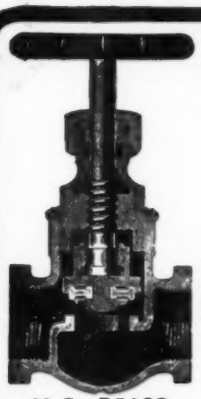

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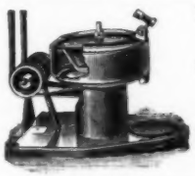

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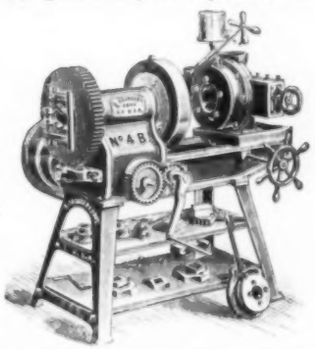

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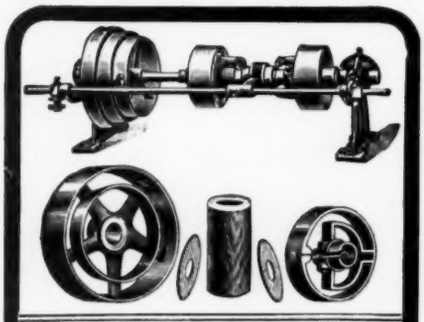

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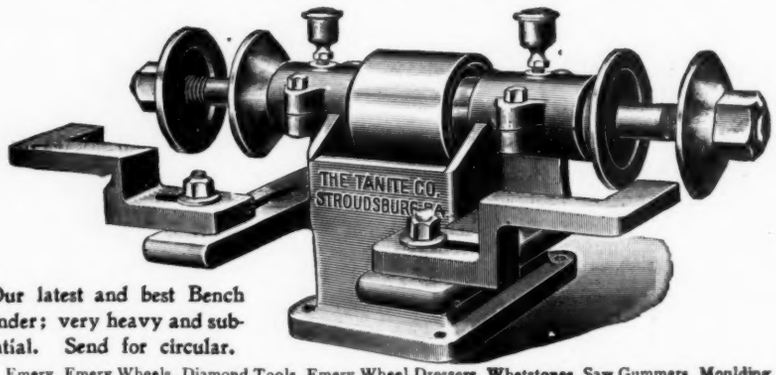

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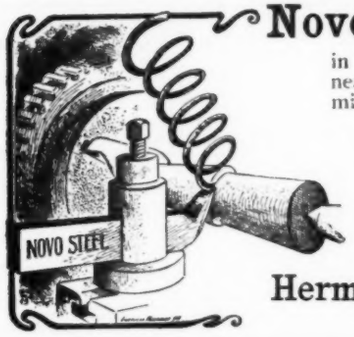

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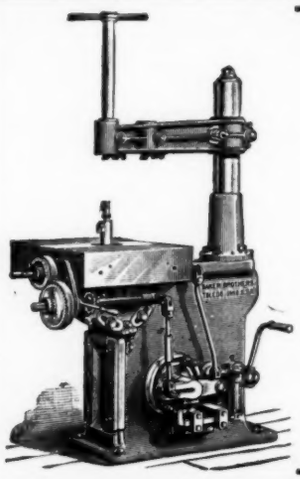

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The Colburn Keyseater

with automatic feed and automatic relief and stop. Built in eight sizes.

Does a large variety of other work besides keyseating, such as internal slotting, internal ratchets, internal gears, etc. Work chucked any way, by the bore, by faced hub or rim.

We also build the best Tapping and Boring Machines

for tapping Pipe Fittings and flanges from 2 in. to 16 in.

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will interest you if you're looking for something exceptionally good in Punches and Shears. The vital parts of a press of our type are the Pitman, Connecting-Rod and Crosshead and the means of transmitting power through them. All these parts are faithfully portrayed in our catalog and their strong points described in good, plain English.

If you have any use for Punches and Shears you'll find its contents well worth your time.

Do you say, "mail it"?

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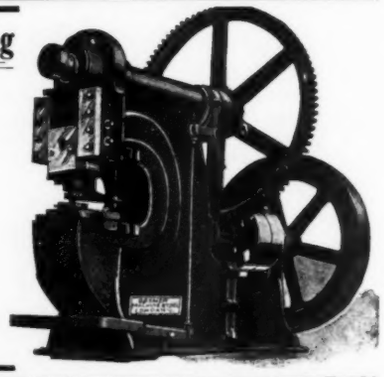
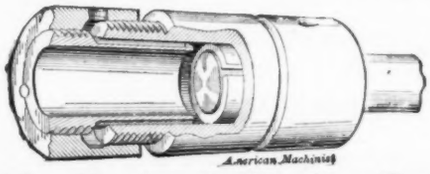


The Heavier the Load, The Tighter the Grip.



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Wood Turning Lathes, 10" swing.
Turret Head Chuck Lathes, 16," 20," 30" swing.
Stud and Bolt Lathes, 16" swing.
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Facing Lathes, 22," 24" swing, with or without turret.
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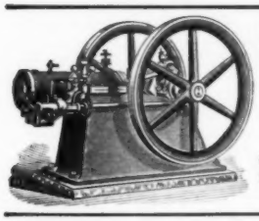

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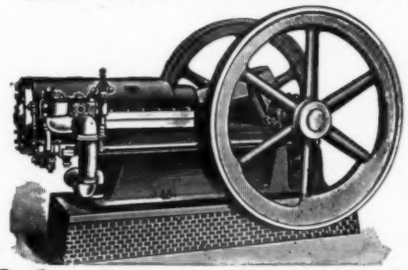

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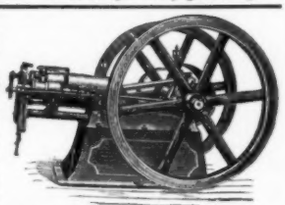

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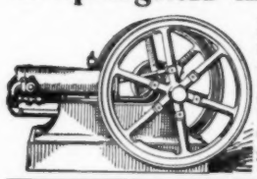

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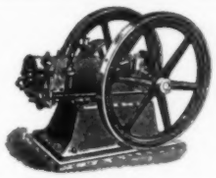

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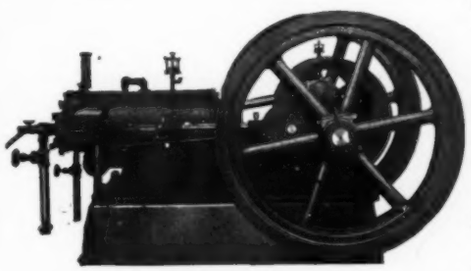

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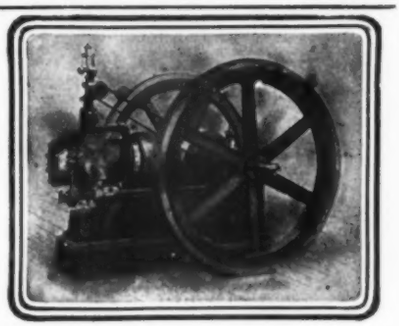

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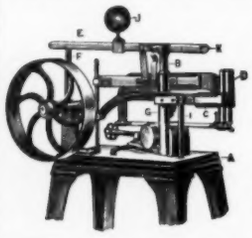

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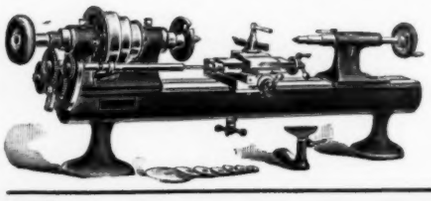

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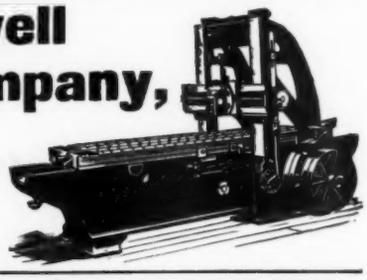

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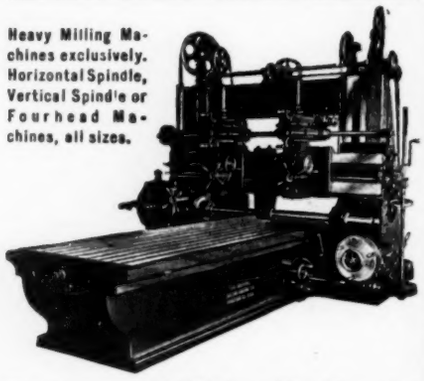

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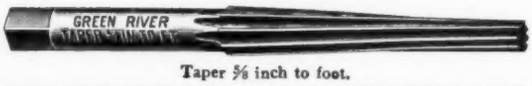

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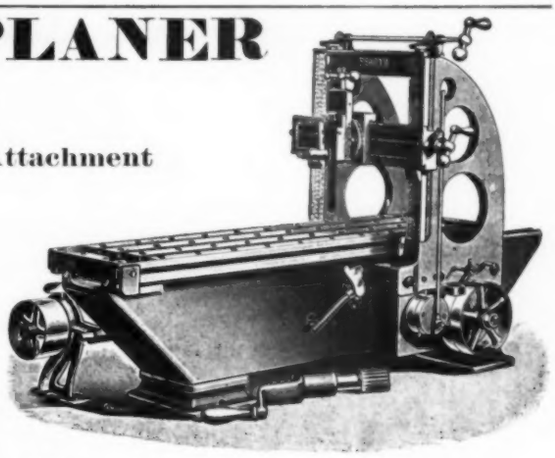

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Price, including Countershaft and Hand-power Attachment
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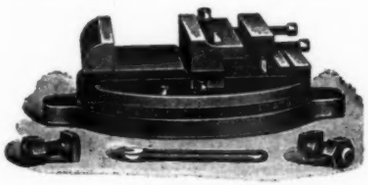

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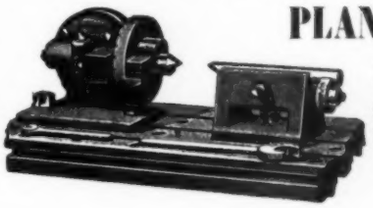

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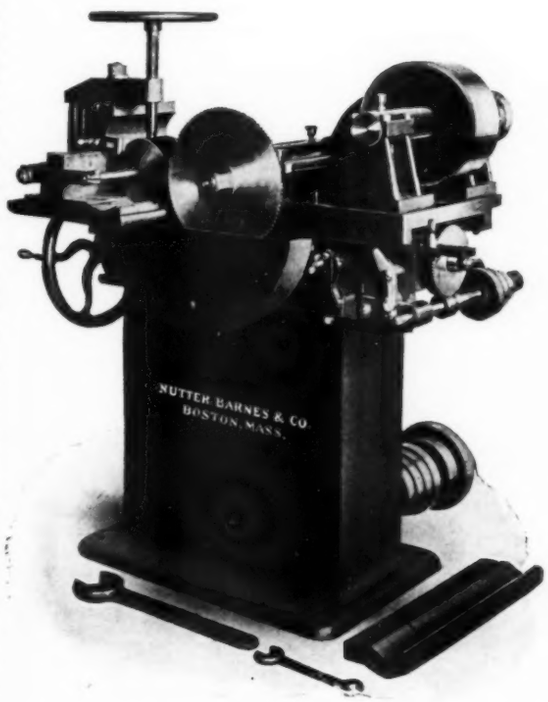
This Metal Saw Cutting-Off Machine



is just the tool you need for cutting steel or iron from the bar; or when you have blanks to cut or finished stock that must be cut square to exact length. It does a variety of work usually done on a Milling Machine and is constructed on similar lines, but the advantages over the Miller and other machines are the reasons for its use in so many machine shops. Many times you are handicapped using a machine in which the stock revolves, because such a machine will only cut stock of a certain shape or size, while our Cutting-Off Machine will take in and cut off any shape or size stock within its range. We use a saw 13 inches in diameter and only ⅛ inch thick, which reduces breakage of saws to a minimum, besides saving about 10 to 20 pounds of stock in a day's cutting. The machine is constructed of the best material throughout and is a first-class tool in every respect. With our Automatic Saw Sharpener it costs practically nothing to keep your saws sharp and always in good condition. We will be glad to send you complete descriptions fully covering both tools, and you'll be pleased with the details when you get them. Don't you want them *Now!*

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Expands our business and expands your capacity and profits. A set of Nine Nicholson Expanding Mandrels will fit every sized hole from one inch to seven inches, and will do away with the pile of solid mandrels you now use. They hold the work better and there is no time wasted calipering a hundred to find one to fit. The scrap iron value of a ton or two of solid mandrels will about pay for Nicholson's Nine. The space saved in storing them can be used more profitably and the time saved — well that's where the ultimate profits come in. If you want something good to read we'd suggest our "Mandrel Book."

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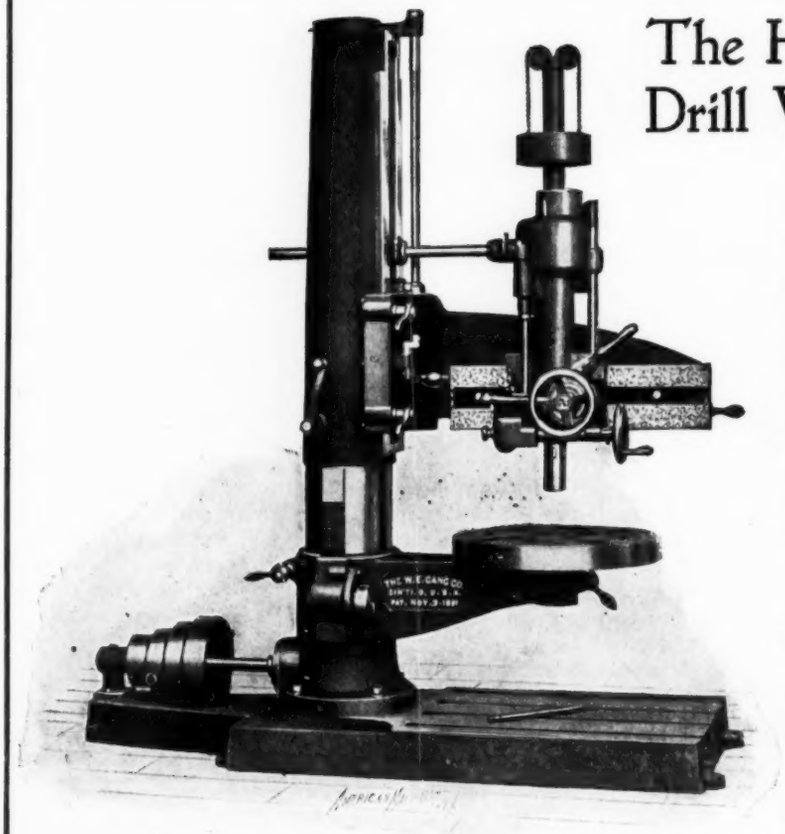

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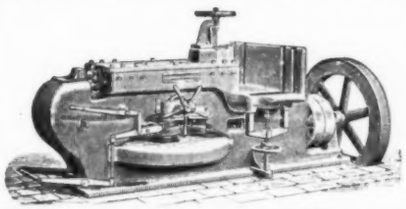

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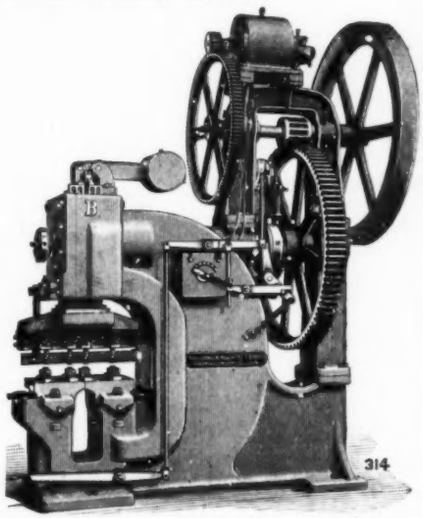
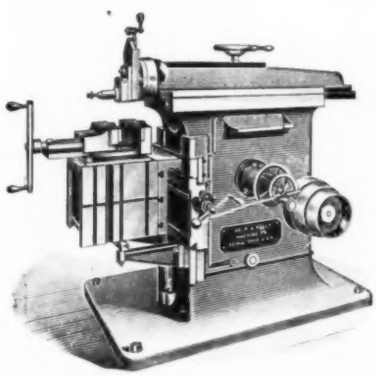


The Kelly Shaper—
The Shaper That Meets Every Shaper Requirement.



Shaper work is made profitable or unprofitable by the way it is handled. If the operator has to stop work and leave the working side of a shaper to change the stroke it's a time-killing, m o n e y - l o s i n g proposition. Kelly Shapers are not built that way. The operator d o e s n ' t have to step out of his tracks to change the stroke from extreme length to shortest desired. There's no stopping work, no leaving machine, no losing time. The change is made *instantly* and the stroke securely locked. There are no gears used to operate the feed on a Kelly Shaper and no noise in running. The only time a Kelly Shaper stops is when work stops. That's why Kelly Shapers meet every shaper requirement and are used in so many good shops. Made in 15″, 16″ and 20″ Plain Geared Crank, and 20″ to 26″ Back Geared Crank. If you want to read some good, common sense shaper talk get Kelly's catalog.

The R. A. Kelly Machine Company,

P. O. Box 488, Xenia, O., U.S.A.

The Greatest Strength with the Least Weight may be found in

Shelby

SEAMLESS

Steel Tubing

That's why it is so popular for hollow shafting, hollow axles, roller bearings, hollow spindles, locomotive bushings, hydraulic tubes, pinion bushings, and a hundred other similar purposes.

This tubing is cold drawn from the best quality low carbon, open hearth steel, containing an extremely low percentage of sulphur and phosphorus. It is soft, ductile and easily worked.

Practical tests have proven that this tubing can be handled with less loss in such operations as beading, expanding, flanging and welding than any other form of tube. It machines readily and cuts freely and clean. The uniformity of size and gauge insures closer shop work and better fitting.

Write for particulars and get a copy of our book of sizes and weights.

Shelby Steel Tube Co.

GENERAL SALES OFFICE:

Pittsburg, Pa., U.S.A.

WELLS BROS COMPANY "LITTLE GIANT"
SCREW-CUTTING TOOLS AND MACHINERY
W.B.Co.
W.B.Co.
POPULARITY
"Little Giant" Screw-Cutting Tools and Machinery have been placed on the Pedestal of Popularity by His Majesty, the American Mechanic, there to remain till time and the ingenuity of man shall produce better tools for the same uses. "Little Giant" Taps, Dies and Screw Plates are veritable little giants in the hands of a good mechanic, and their high quality and accuracy are reflected in the quality and accuracy of the work which they produce.
"QUALITY"
has been our watchword from the very beginning of this business, and though here and there will be found the short-sighted, to whom a fancied low price makes a stronger appeal, we are content with the steady and substantial growth of business which comes from producing tools of high quality and absolute dependability at really reasonable prices. You should have a copy of our New Catalog. May we send it? A postal will do.
NEW LITTLE GIANT SCREW PLATE
WITH
ADJUSTABLE TAP WRENCH
Wells Bros Company, Greenfield, Mass. U.S.A.

Gorton Grinders are for the finishing of flat surfaces of metals — any kind.

They do this grinding quickly.

They do it accurately.

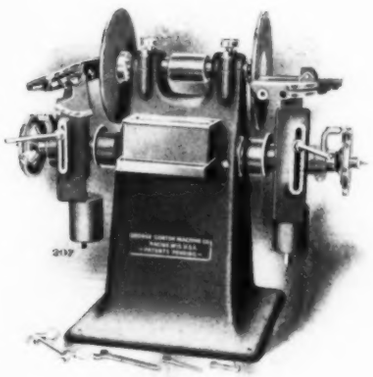
They save a great deal of time which in turn stands for money gained.

Above all, the finished product is accurate—absolutely so.

If you hope to successfully contend with others in getting your share of good things, Gorton Grinders help to smooth the way.

You can finish things on a grindstone — in a way, or you can file 'em — in a way also, but neither way is right, and if long persisted in will lead to grief.

GORTON GRINDERS



You might mill your flat surfaces or you might try the lathe or planer with more or less success.

What's the use?

There's only one way — one proper way.

That's thro' the use of Gorton Grinders.

Gorton Grinders cut the time of finishing flat surfaces down to ½ or ⅓ of that taken by any other method and when the work is done, it's done, done right and out of the way; there's nothing doubtful about it.

These Grinders have had deliberate design for the work they are intended to handle.

They have had the test of time and the little faults that time brings forth have had careful elimination, so that now Gorton Grinders represent everything that's best in tools of this kind.

The grinding is done by steel discs to which emery cloth or paper is fastened.

These wheels can be run at any speed without fear of explosion.

These faster speeds afford faster cutting.

Remember, you can save from 50% to 75% in finishing flat work by using Gorton Grinders, and that any neglect to investigate thoroughly shows a careless regard for your own financial good.

We are pleased to send the book, which goes into details, shows examples of work and testimony of users.

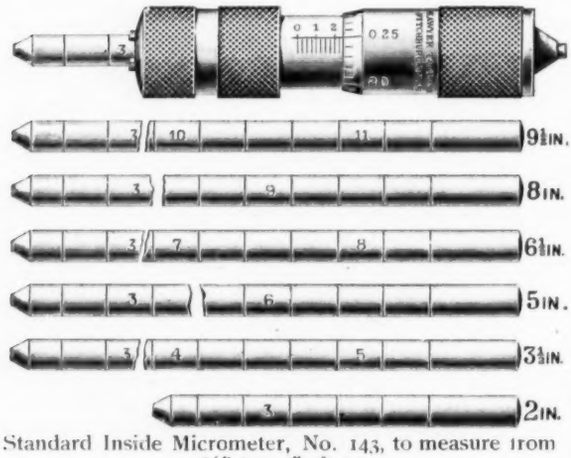
Geo. Gorton Machine Company,

Racine, Wis., U.S.A.

Selig, Sonnenthal & Co.,
85 Queen Victoria Street, London,
carry all styles in stock.

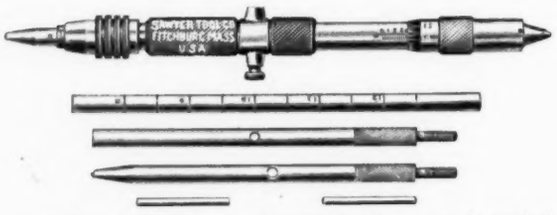
Proper Work Requires Proper Tools.

Here are shown a few of the many made by the **Sawyer Tool Manufacturing Company.** These are tools of rare merit. They are serviceable, accurate, and sold at a reasonable price by all prominent dealers. If your dealer does not have them we will see that you get them at the proper prices. The prices given are list prices.



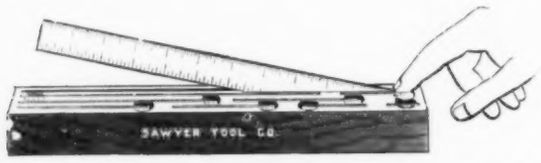
Standard Inside Micrometer, No. 143, to measure from 2½″ to 13″, $4.00.

Micrometer Caliper Gauge No. 141, for transferring sizes or for use as a limit gauge, $2.00.

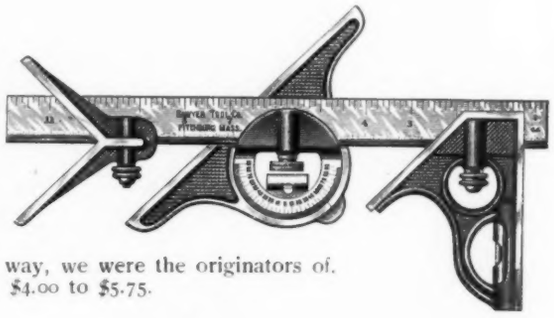


Inside Micrometer, telescoping, No. 140, intended for large work; capacity from 8″ to an indefinite length. A mighty useful tool in any man's kit. One of the features making it so is the telescope. $4.00.

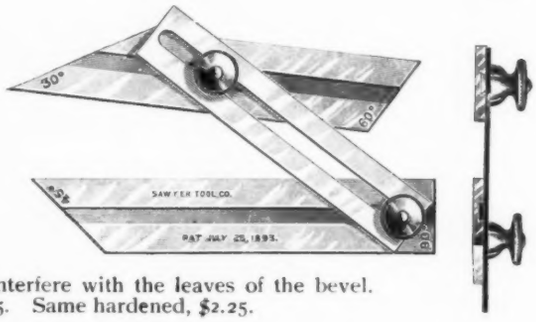
Spring Tempered Rules, No. 18B, with graduated ends. Ranging in prices from .25c. to $7.00. By the way, we make 26 different styles in rules and are sure to have just what you want.



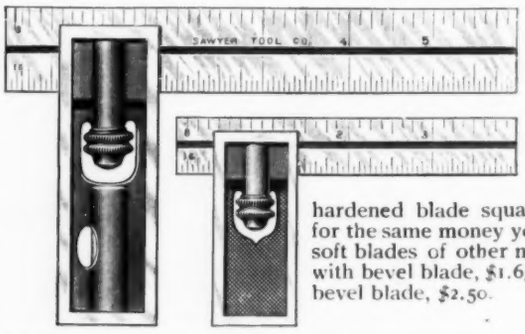
Case of Rules, No. 30, contains all lengths of rules from 1″ to 12″ inclusive, also 4″ Narrow Rule and hardened Center Gauge. $4.00. Rules all tempered.



Combination Set, No. 35, made in all sizes from 9″ to 24″. Has our late improved Bevel Protractor and our hardened blade, which, by the way, we were the originators of. $4.00 to $5.75.

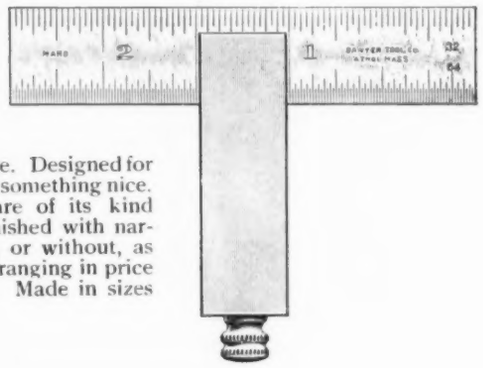


Combination Bevel, No. 90, the very best bevel made. With this bevel you can get over 100 more positions than with any other bevel made. The link does not interfere with the leaves of the bevel. $1.75. Same hardened, $2.25.



Hard blade Square, No. 44. These squares are made with fine grey iron stocks, hardened blades. These squares, like all our hardened blade squares, you can buy for the same money you have to pay for soft blades of other makes. 4″, $1.25; with bevel blade, $1.65. 6″, $2.00; with bevel blade, $2.50.

We were the first to use the UNION LABEL.



No. 37, Hard Square. Designed for workmen who require something nice. The only hard square of its kind made. They are furnished with narrow and bevel blades, or without, as the customer wishes, ranging in price from $2.00 to $5.00. Made in sizes from 2½″ to 9″.

We have a catalogue describing our complete line of manufacture, which is yours for the asking.

Our foreign representatives are: C. W. Burton, Griffiths & Co., Ludgate Sq., London, Eng., and De Fries and Co., Dusseldorf, Germany.

Sawyer Tool Manufacturing Co., FITCHBURG, MASS., U. S. A.

From Pole To Pole The World Around,

No better tools have e'er been found.

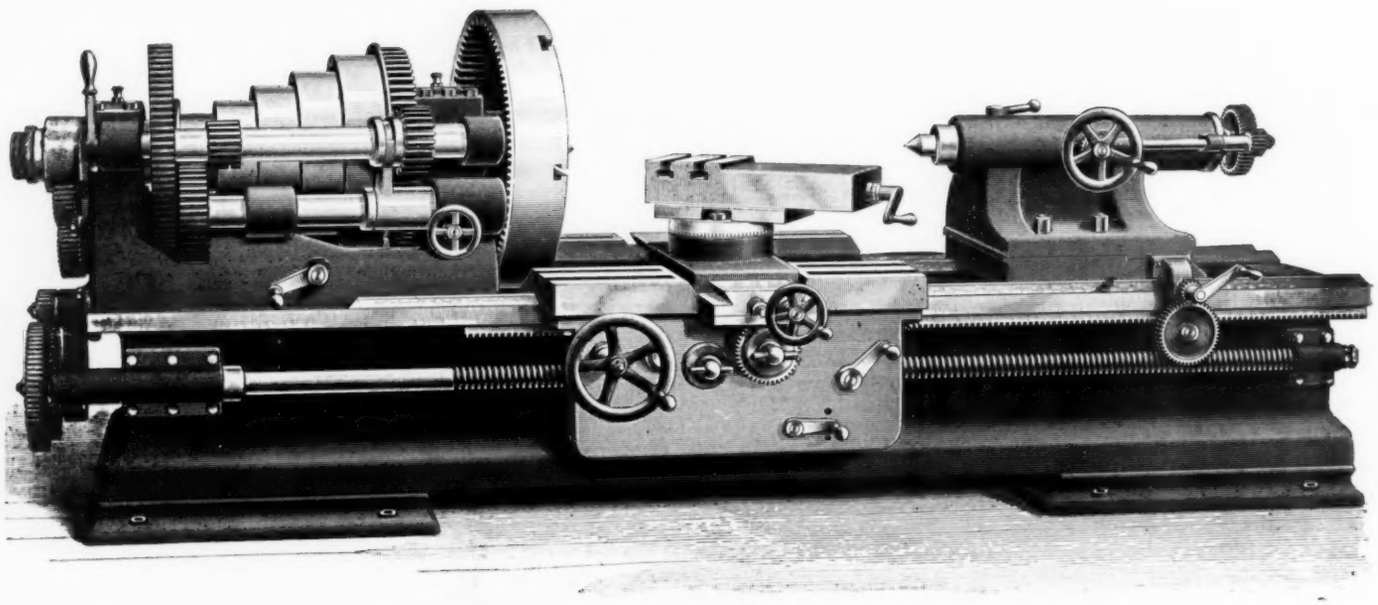
Slocomb Micrometer Calipers are made in many sizes, large and small; they are practically made by practical men for practical users on practical work; they represent the extreme in micrometer accuracy; are made to last and to withstand rough usage. They are sturdy, accurate tools for every-day use; none are better made at any price. Some may have a higher finish on portions; you are asked to pay for this polish and unnecessary refinement. Slocomb tools have the work put where it means something, and are so made that they can be sold within reason. You can well afford to use them.

A little book on micrometers is yours on request.

'Twere well to send for it to-day.

J. T. Slocomb & Co., Providence, R. I., 227 Eddy Street.

ACCURATE MACHINE TOOLS.



DAVIS 36" TRIPLE GEARED ENGINE LATHE.

(GEARS CASED.)

Notice instantaneous feed change lever on front of headblock.

....WE BUILD....

ENGINE LATHES

FROM 10" TO 42" SWING

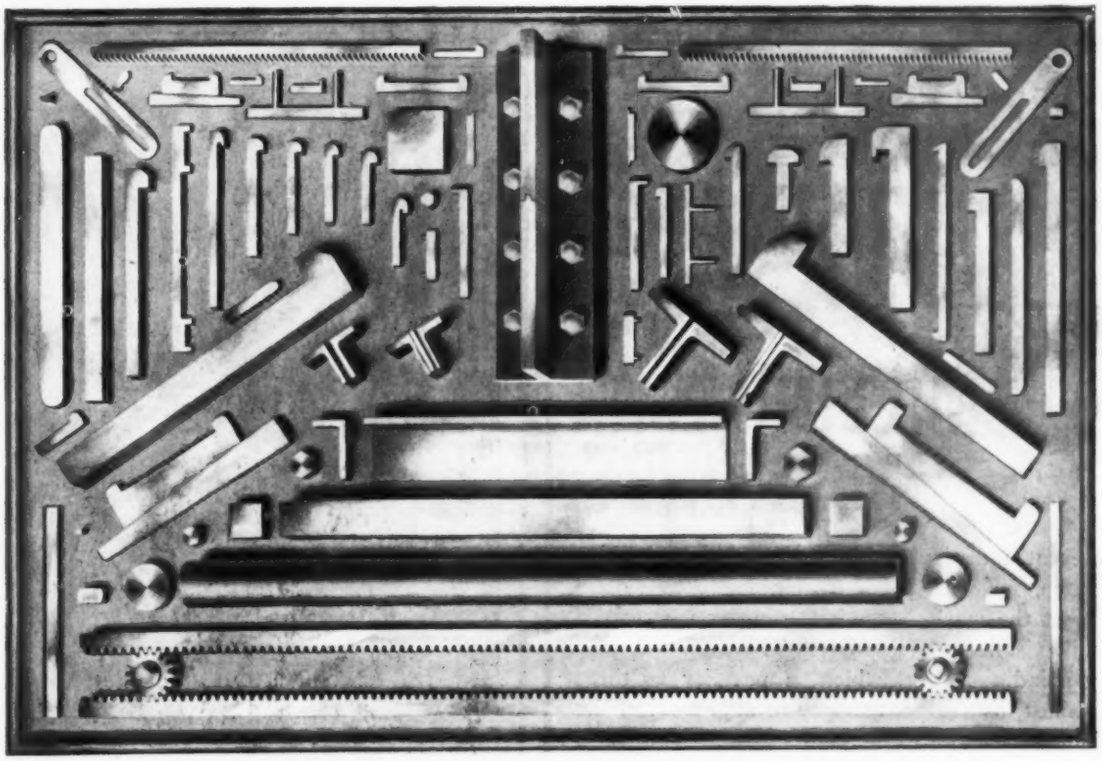
Any length of bed required. Our lathes are made for hard and continuous service. ACCURACY GUARANTEED.

FOR SALE BY REPRESENTATIVE DEALERS IN EVERY LARGE CITY.

For further particulars and catalog address,

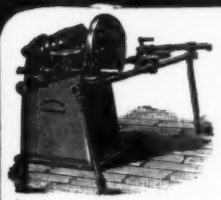
THE W. P. DAVIS MACHINE CO.,

ROCHESTER, N. Y., U.S.A.



OUR SPECIALTIES:
- **CONNECTING ROD KEYS, GIBS AND KEYS, or MACHINE KEYS of any type.**
- **STEEL MACHINE RACK in almost any pitch or length, no butting required.**
- **Also COMPRESSED STEEL ELEVATOR GUIDES ready to erect.**
- **Our Catalog and Price List will interest you. Send for it.**

STANDARD GAUGE STEEL CO., Beaver Falls, Pa., U.S.A.



Government Specifications Call For Our Pattern Makers' Lathes

And the reason why they do is that we are specialists in this particular line and do specially good work in it.

We give these lathes the same careful attention we do our engine lathes. That's unusual in wood working tools, but we find it pays, and we carefully scrape and fit every bearing and test each lathe belted up and running at a high speed before it leaves our hands.

The result is that when a man buys a lathe from us he finds it so entirely different from ordinary pattern makers' lathes that he is pleased.

Patterns bear so important a part to the finished product that every care should be exercised to have them accurate in the extreme.

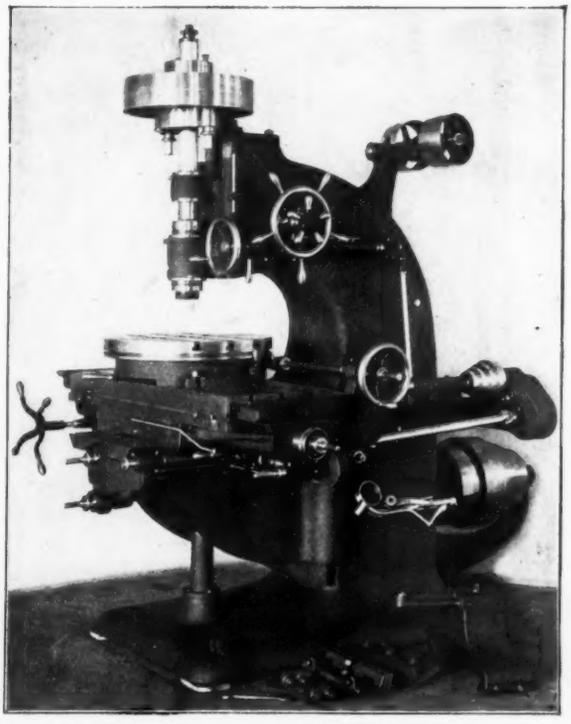
A pattern maker is a high priced man, and if you can save his time it's money in your pocket.

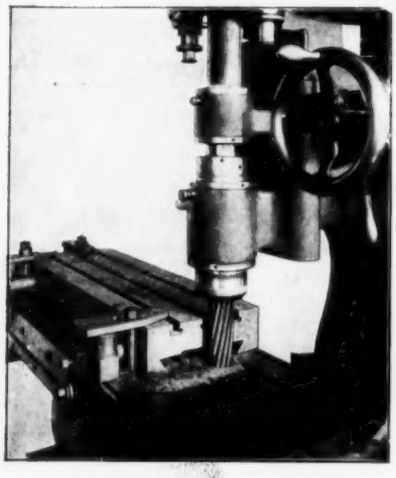
We have a special catalog for these lathes and would like to send you a copy.

Fay and Scott
Dexter, Me.

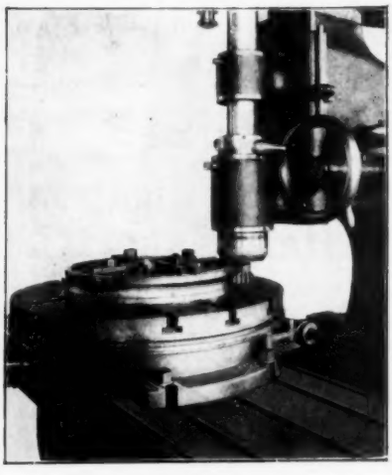
BECKER-BRAINARD VERTICAL MILLING MACHINES

represent a distinct advance in milling machine practice, for with them it is possible to rigidly support the work beneath the cutter where it is readily visible and accessible. The patented auxiliary spindle support which is peculiar to these machines insures permanency of alignment of the spindle in relation to the platen.

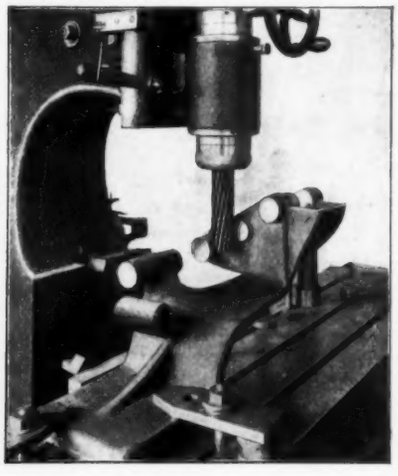




A Vertical Miller finishing ends of milling machine table. Economy compared with planer, three to one.



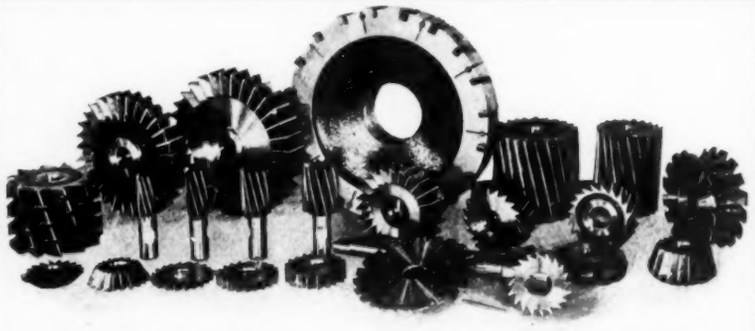
A Vertical Miller finishing recess in periphery of a circular casting one-third faster than on a lathe.



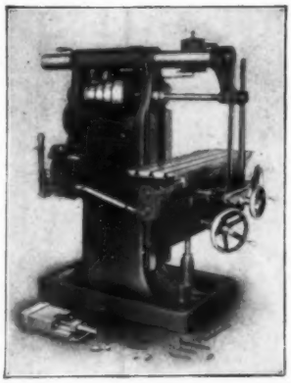
A Vertical Miller finishing spots on outside surface of bracket casting.

BECKER-BRAINARD MILLING MACHINE COMPANY

Hyde Park, Mass., U.S.A.

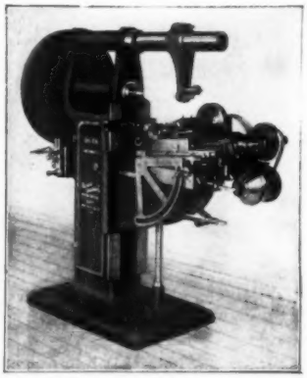


MILLING CUTTERS of every description carried in stock. SPECIAL CUTTERS designed to accomplish specific results.



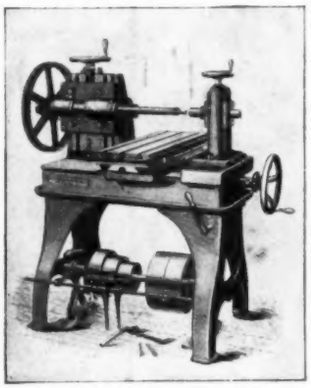
No. 3. New Model, Plain Horizontal Milling Machine

with positive gear feed eliminating all belts and pulleys. Twenty changes of feed for each spindle speed.



Automatic Gear Cutting Machines

are built in three sizes, 18 in., 24 in., and 36 in., for cutting spur, bevel and worm wheels, and also for cutting spur wheels only.



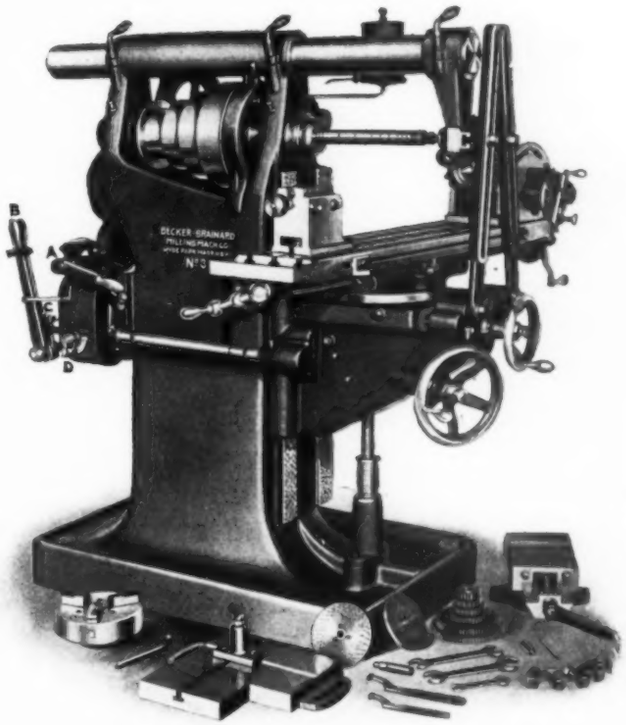
No. 7. Plain Horizontal Milling Machine.

Provided with extra heavy table, screw feed automatically tripped at any position in the entire length of longitudinal feed.

Becker-Brainard

New Model

Horizontal Milling Machines and Automatic Gear Cutters



No. 3. New Model Universal Milling Machine.

With change feed mechanism, locking hand wheel mechanism, telescopic elevating screw, quick change from slow to fast speed by means of levers and rigidity.

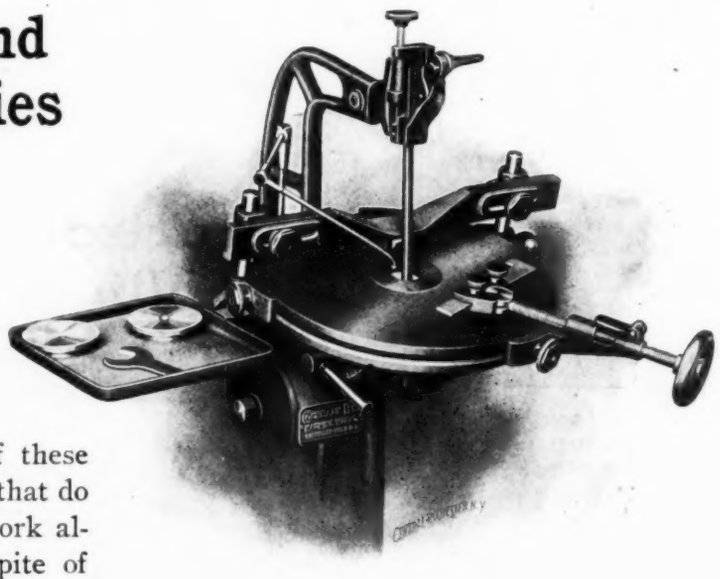
Becker-Brainard Milling Machine Co.,

Hyde Park, Mass.,

U. S. A.

For Sawing Out and Filing Blanking Dies

and work similar to this, **The Cochrane-Bly Filing Machine** will save labor, and what labor it requires may be of the cheaper kind.



It's one of these machines that do accurate work almost in spite of the operator.

It uses common files or hack saw, and sufficient means are provided to allow the files to clear on the return stroke in either direction.

For Larger Cutting

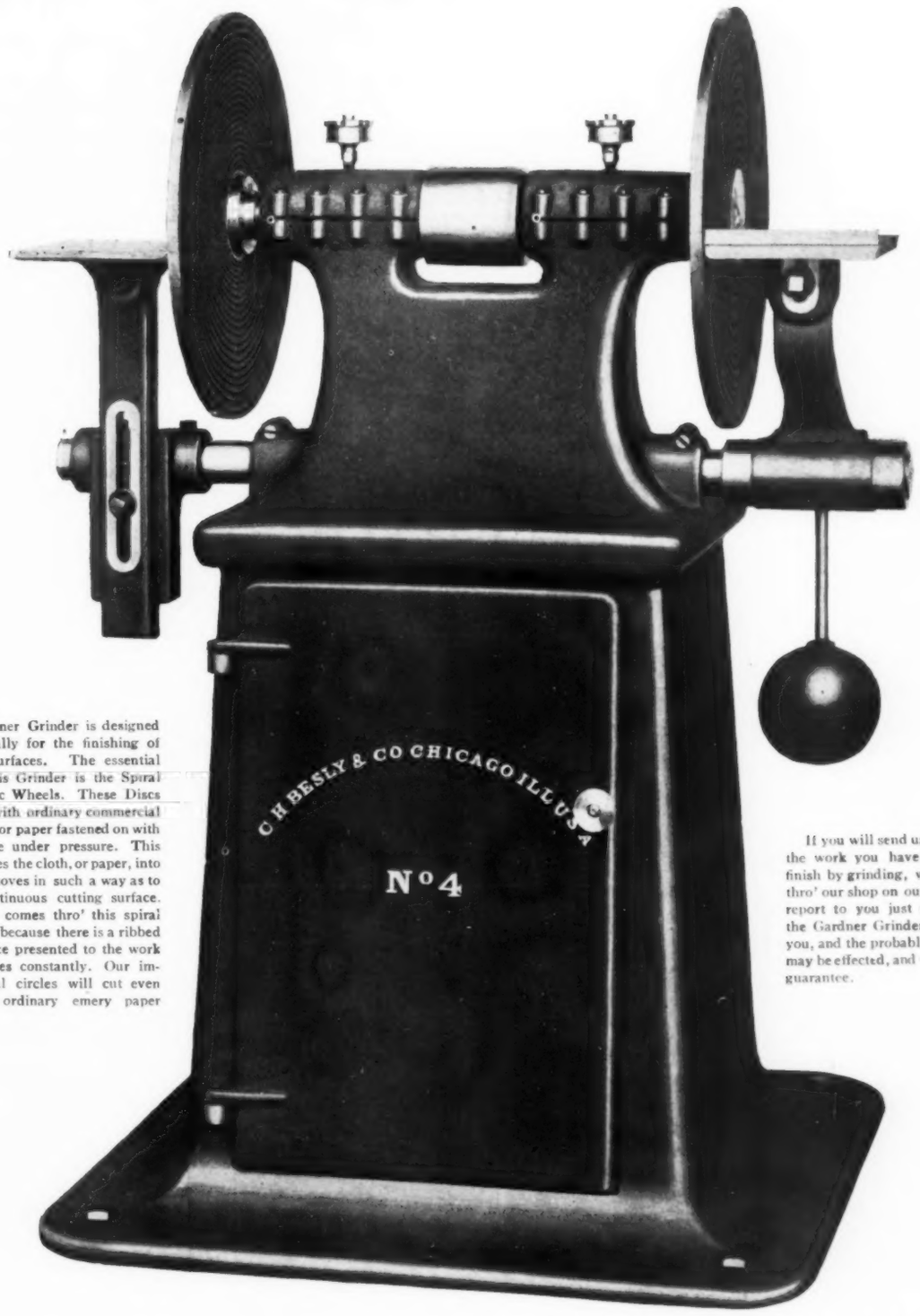
of a somewhat more promiscuous variety, **The Cochrane-Bly Cold Saw Cutting-Off Machine** is about as satisfactory a thing as you could find. It's made of the right stuff in a common sense way, and full of good points and time saving features. You can't put another machine in the space this will occupy that will prove half as convenient or profitable.

You may have a descriptive circular of either or both if you are interested.

Cochrane-Bly Machine Works,

Rochester, N. Y., U.S.A.

The Gardner Grinder—With Spiral Grooved Disc Wheels.

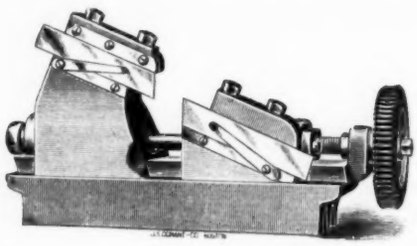


The Gardner Grinder is designed more especially for the finishing of flat metal surfaces. The essential feature of this Grinder is the Spiral Grooved Disc Wheels. These Discs are covered with ordinary commercial emery cloth, or paper fastened on with common glue under pressure. This pressure forces the cloth, or paper, into the spiral grooves in such a way as to afford a continuous cutting surface. Fast cutting comes thro' this spiral grooved disc because there is a ribbed cutting surface presented to the work which changes constantly. Our improved spiral circles will cut even faster than ordinary emery paper circles.

If you will send us a sample of the work you have in mind to finish by grinding, we will put it thro' our shop on our grinder and report to you just exactly what the Gardner Grinder can do for you, and the probable saving that may be effected, and which we will guarantee.

Charles H. Besly & Co., Chicago, Ill., U.S.A.

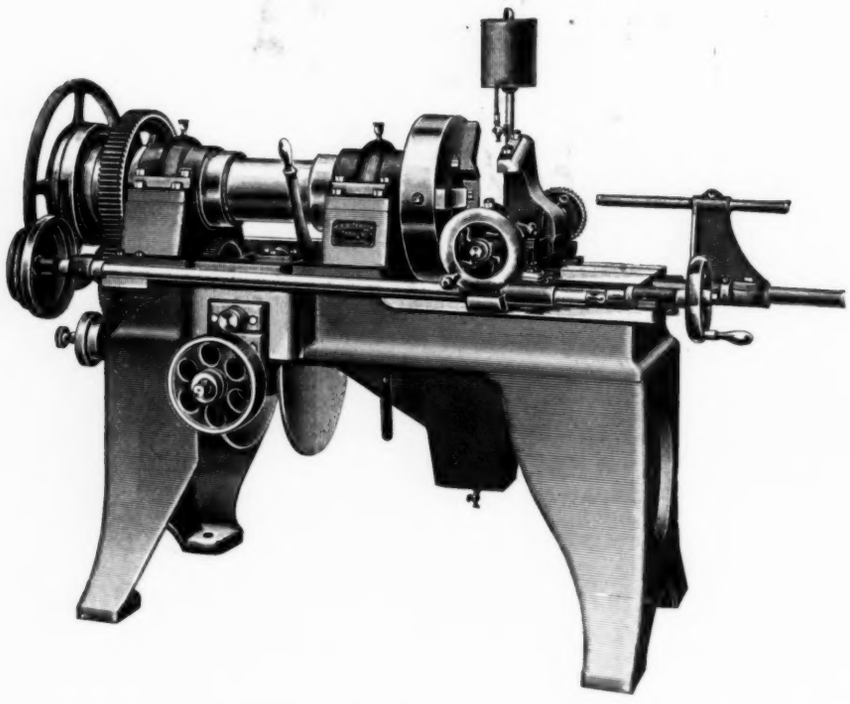
10-12 North Canal Street.



Hurlbut's Patent Cutting-Off And Centering Machines

with the patented device for working two tools in the same cut, will do twice the work with the same amount of power that an ordinary tool will. Each tool is a rest for the other. One tool presses up and the other down, which relieves the strain and leverage on chucks and bearings. Notice the way the tools are set in the blocks. They've got to be in just that position and are bound to cut square if ground square. Then there's the hinged receptacle under the machine which catches the chips and oil, drains off the oil, and dumps the chips dry. The patent shipper, the patent nut and the centering device are also interesting, but we'll keep these until you get the circulars which we shall be pleased to send.

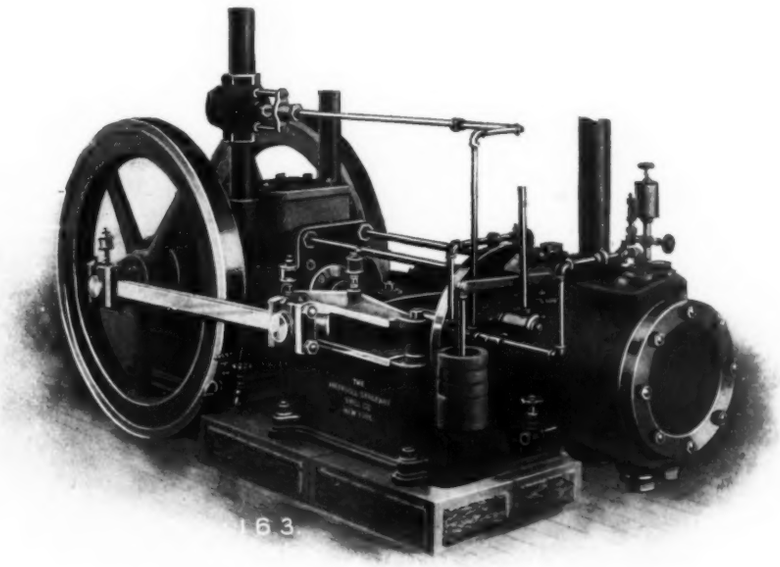
Hurlbut-Rogers Machine Company,
South Sudbury, Mass., U.S.A.



AIR COMPRESSORS

For Machine Shop Use.

Every day the use of compressed air is increasing in machine shops. Chipping, riveting, caulking, pumping and lifting by this means have become common practice, and this type of compressor is especially adapted for use in this connection.



It is money in your pocket to use a properly designed machine and as this one has been tested by long and severe use, it will be found to give very satisfactory machine shop service.

It may be run by electricity, gas or steam drive, and we will be glad to consult with you on compressed air matters and to send you our literature on the subject.

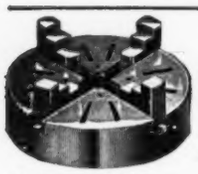
The Ingersoll-Sergeant Drill Co,

26 Cortlandt Street, New York, U.S.A.

Kaiser Wilhelm Strasse 2, Berlin, Germany.

Cleveland, Ohio. Chicago, Ill. Boston, Mass. Pittsburg, Pa. Philadelphia, Pa.

114A Queen Victoria Street, London, E. C., England.



YOU NEED CHUCKS

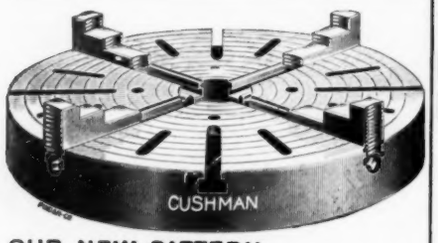
For your Lathes, Grinding Machines, Milling Machines, Screw Machines, Upright Drills, Cutting-Off Machines, Drill Lathes, Boring Mills, Etc., Etc.

DO LIKE THOUSANDS AND SEND YOUR ORDERS TO US.

THE E. HORTON & SON CO., WINDSOR LOCKS, CONN., U.S.A.

74 Page Catalog Free.

Or Chas Churchill & Co. Ltd., London, Birmingham, Manchester and Glasgow. Schuchardt & Schutte, Berlin, Cologne, Brussels, Stockholm, St. Petersburg and New York. Fenwick, Freres & Co , Paris, France. Van Reitschoten & Houwens, Rotterdam, Holland.



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Flush Screw Heads.
Large diameter recess for flange plate.
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Agents: Chas. Churchill & Co., Ltd., London, England.

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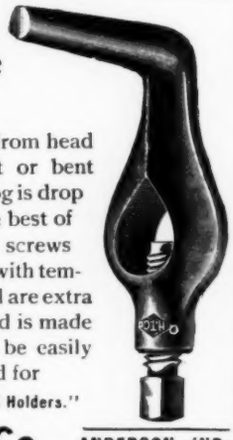

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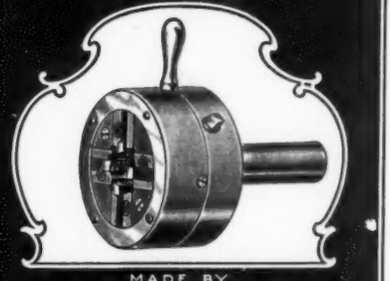

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how pretty a chuck is, nor how smoothly it's finished; if it doesn't hold drills so they wont slip, without chewing the shanks all up, it isn't a good chuck. The Reid Chuck is a good Chuck.

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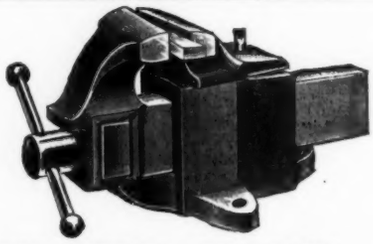

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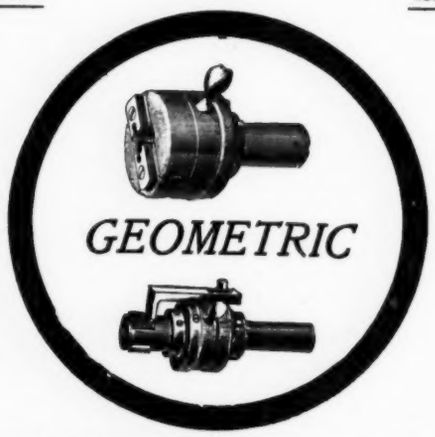
Open and close automatically at the beginning and end of a thread. Start right in and cut to a finish. Change the dies for any diameter.



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Both made with micrometer adjustment for cutting tight or loose fitting thread as desired.

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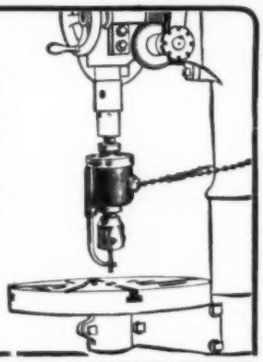

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These Crankshafts are made in any style, length, throw or size not exceeding 2¼" diameter shaft or wrist pin, and are made exactly as ordered. Material and workmanship are the best that can be had. Making these things specially, we can make them at such a price that it won't pay you to make them yourselves. We shall be pleased to have your inquiries.

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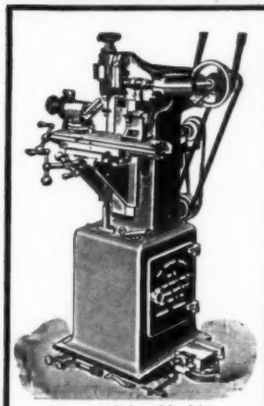

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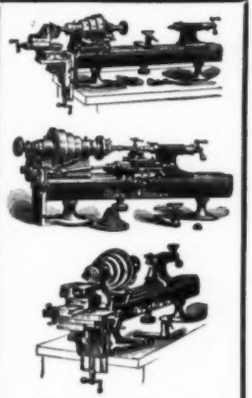

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No. 00	Taps to	1/8 inch.
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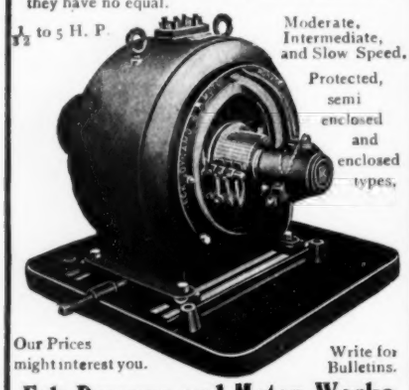

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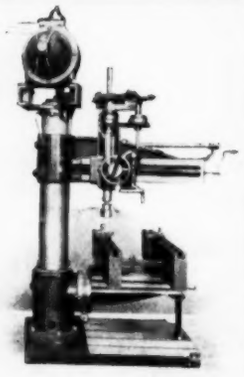

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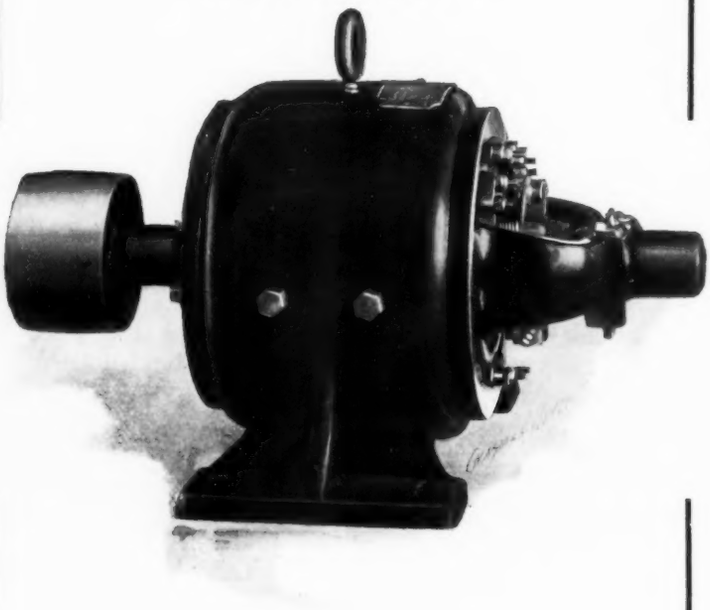

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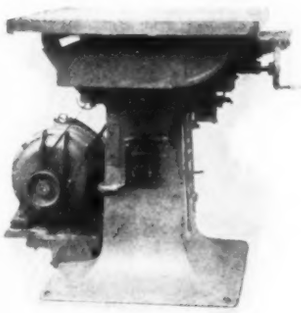
Can be applied to anything where power is required for we make them of

ALL TYPES ALL SIZES ALL SPEEDS



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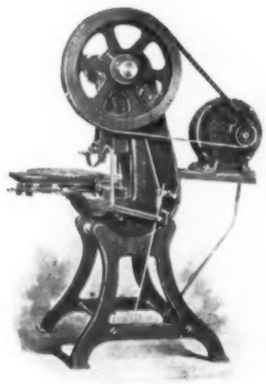

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Standard sizes from 3 to 100 K. W., 110, 220 and 500 Volts.
Motors for direct connection to all kinds of machinery.
SPECIAL DYNAMOS FOR ELECTROTYPERS AND PLATERS.
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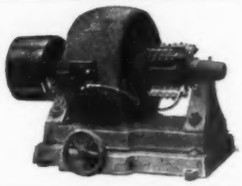

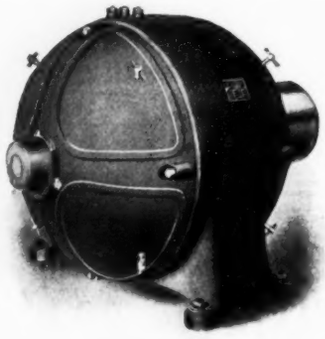

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We also make semi-enclosed and open styles. They are not cheap in price, but when the material, workmanship, efficiency and durability are considered, you save money by buying a "Ceco."
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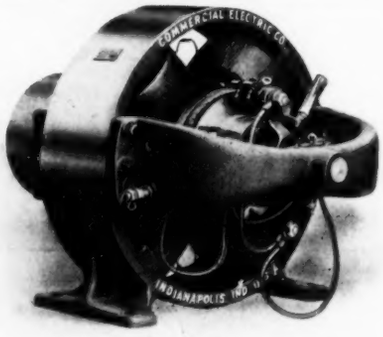

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"ABRASIVE"
EMERY WHEELS

WORK EQUALLY WELL WET OR DRY, AND ARE MADE TO SUIT EVERY PURPOSE FOR WHICH SUCH WHEELS ARE USED.
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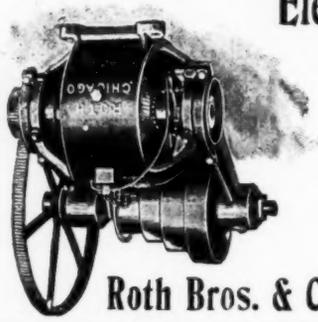

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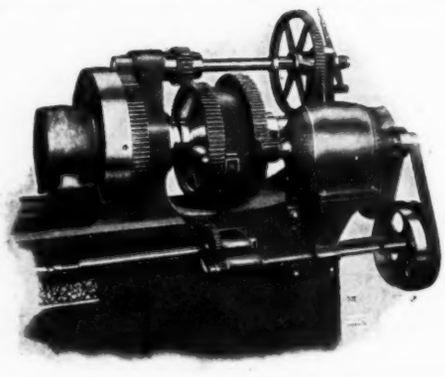

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We make a specialty of direct tool drive, and our small motors from 1/8 to 40 H. P. are designed with this end in view.
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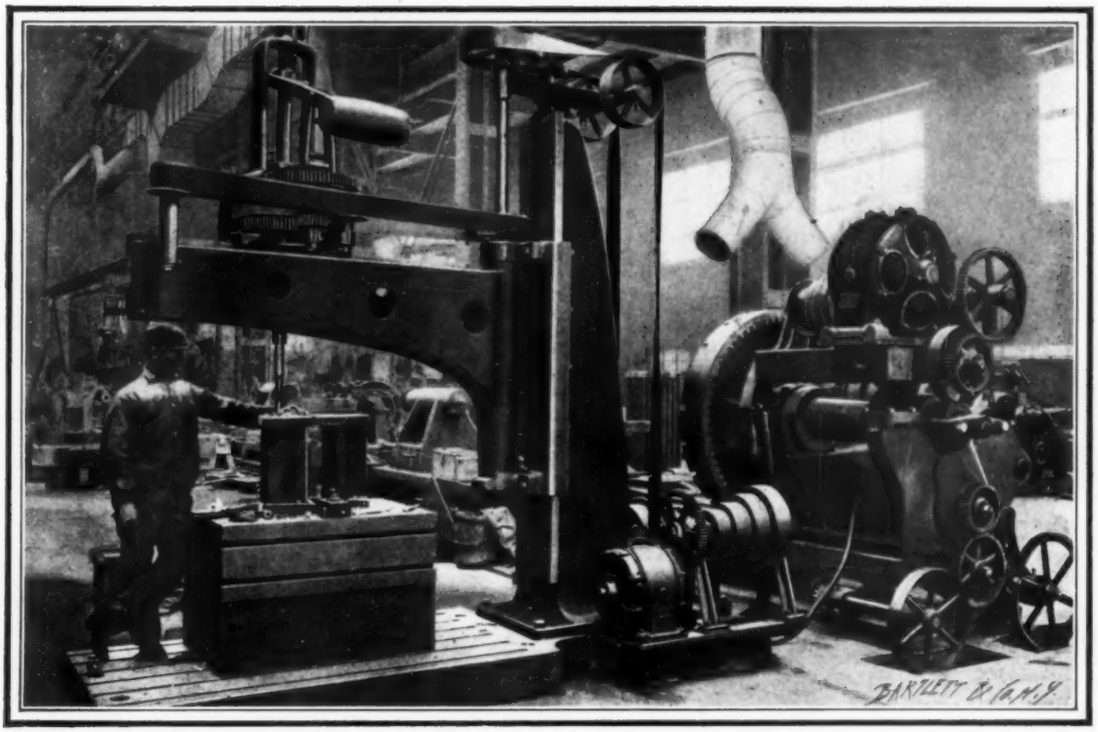
Westinghouse Motors



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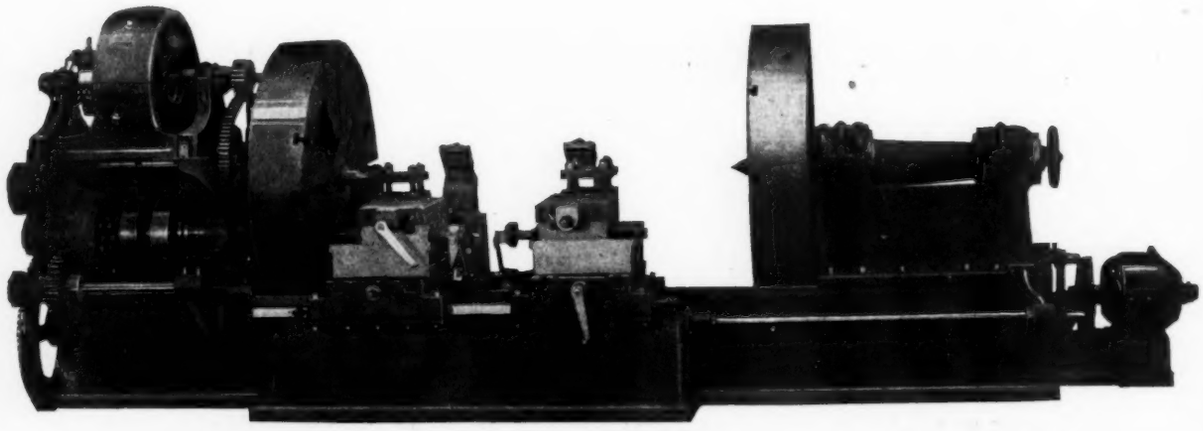

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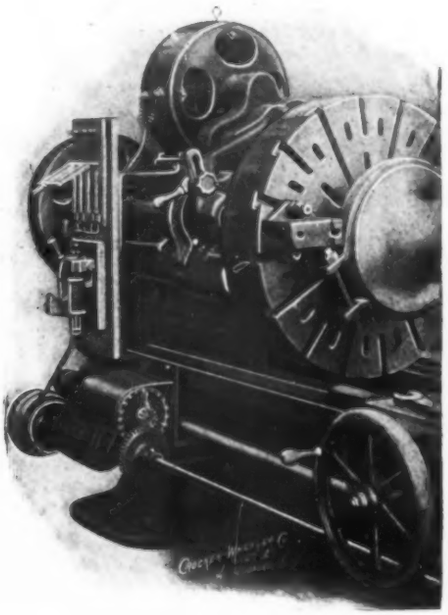
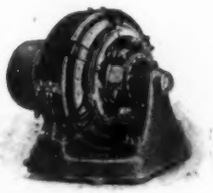
The application of our motors and the use of our system of speed control gives the highest efficiency and greatest convenience in the operation of the machines of your shop.





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Is to buy at the very beginning, **The Very Best Motor Obtainable,** even tho' its first cost may be slightly higher than you expected. Such is

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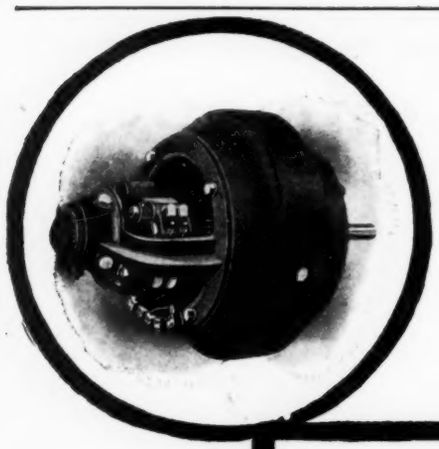

For Direct, Geared, or Belt drive.

1 to 500 H. P.

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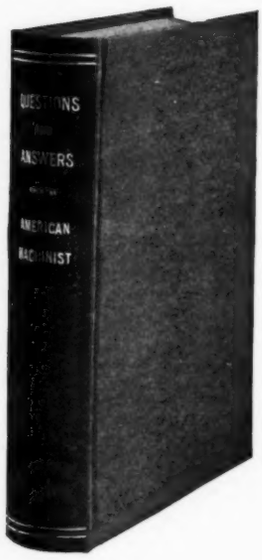

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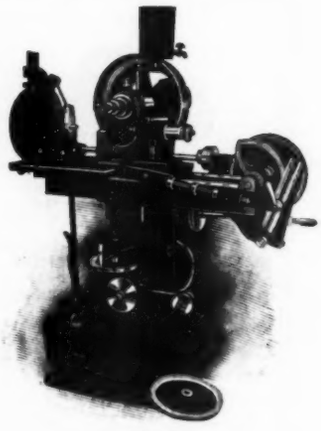

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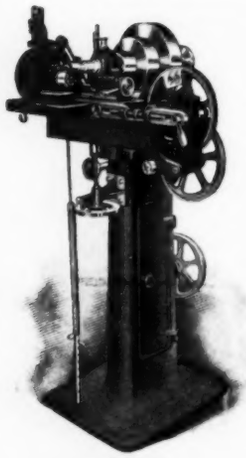

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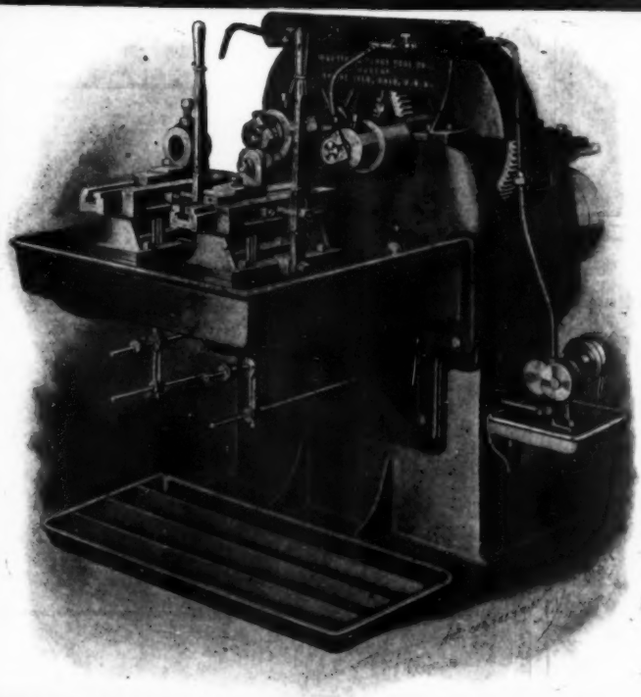

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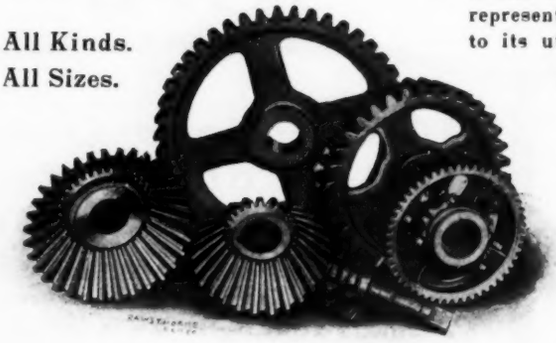

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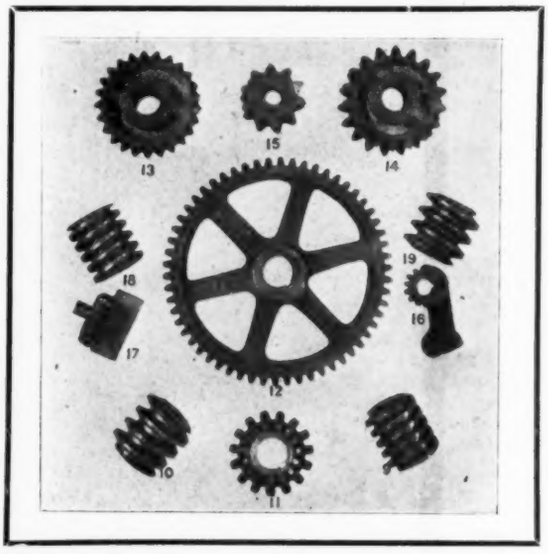

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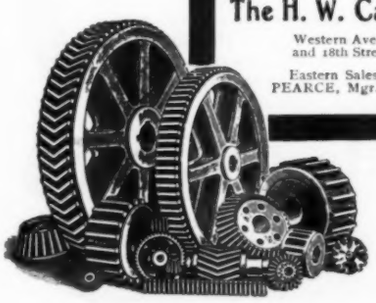

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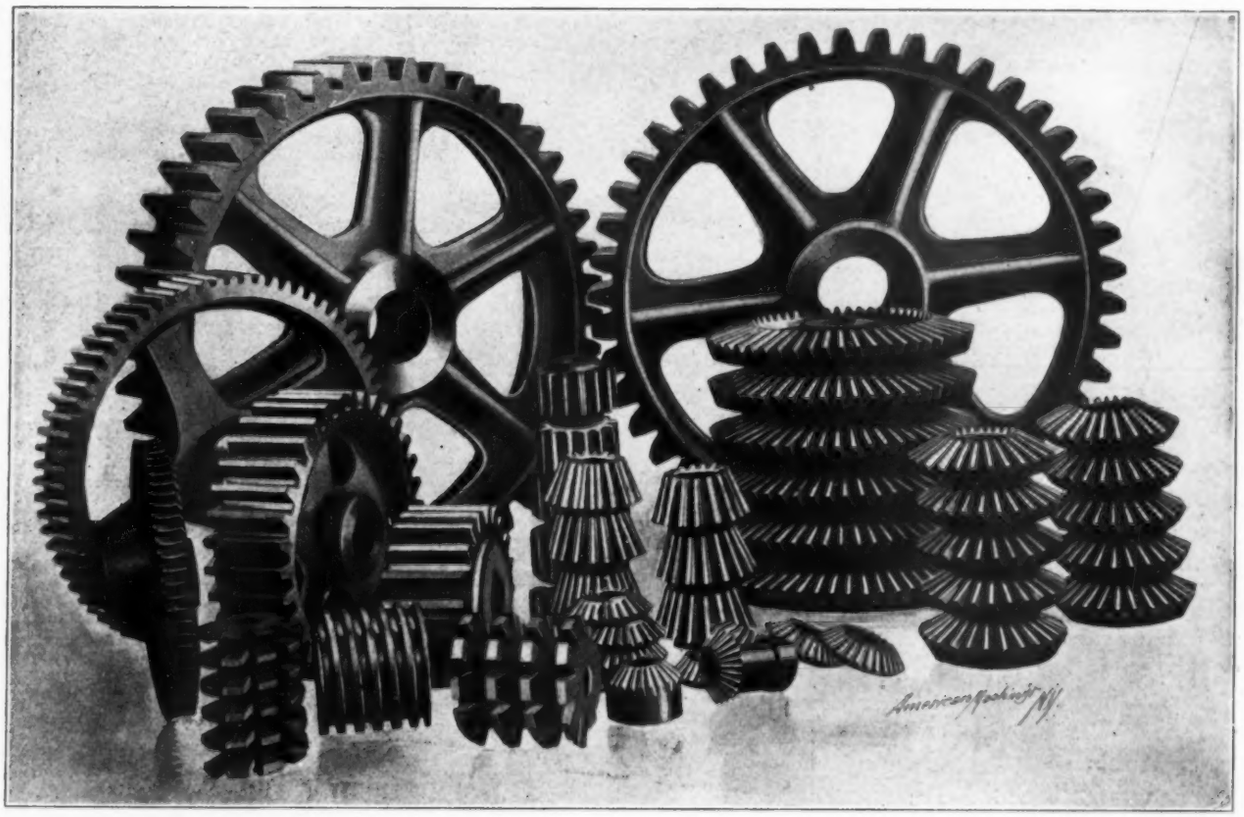

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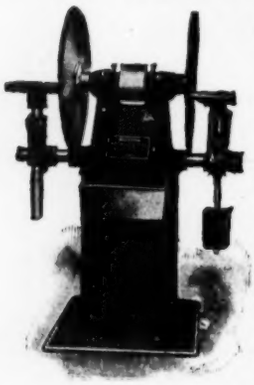

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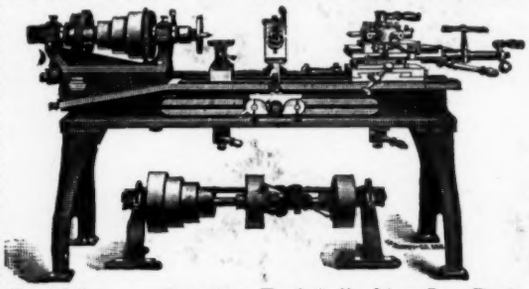

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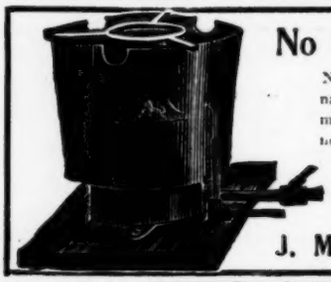

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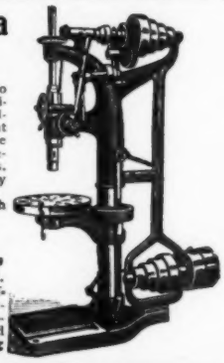

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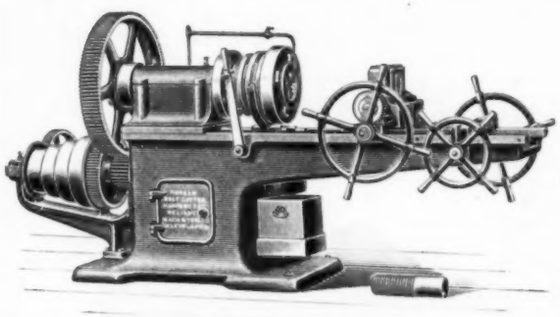

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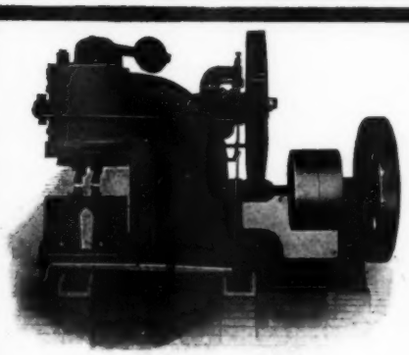

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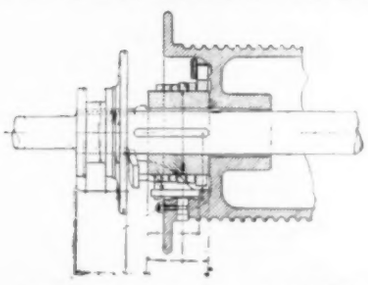

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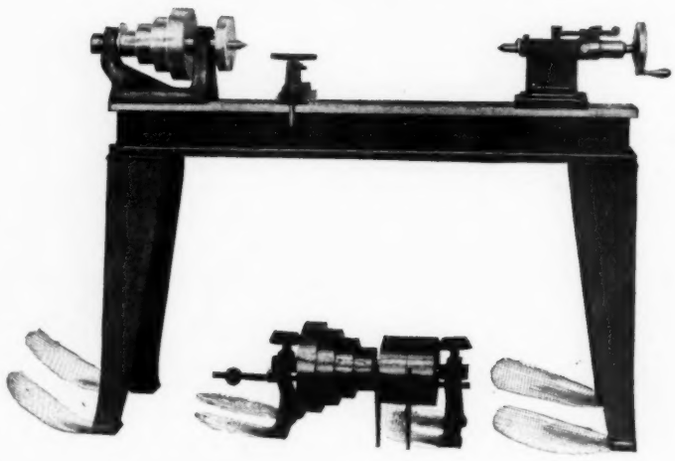

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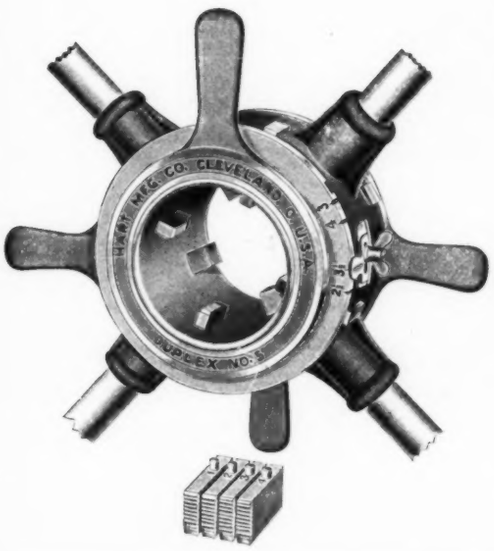

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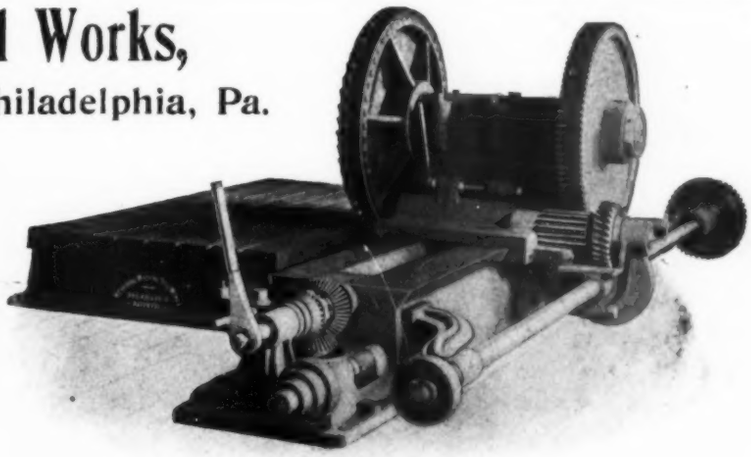

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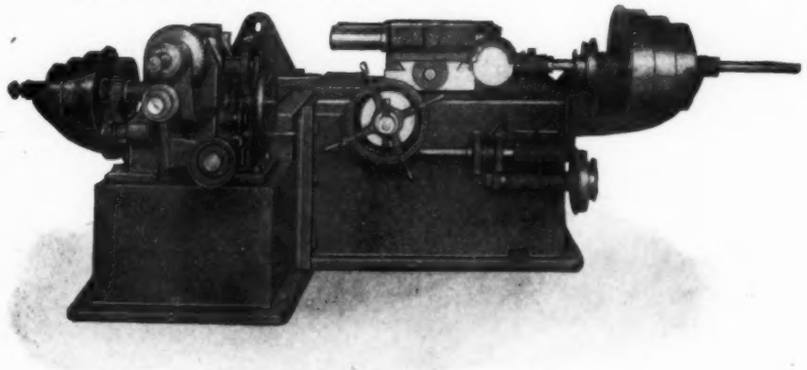

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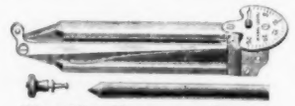

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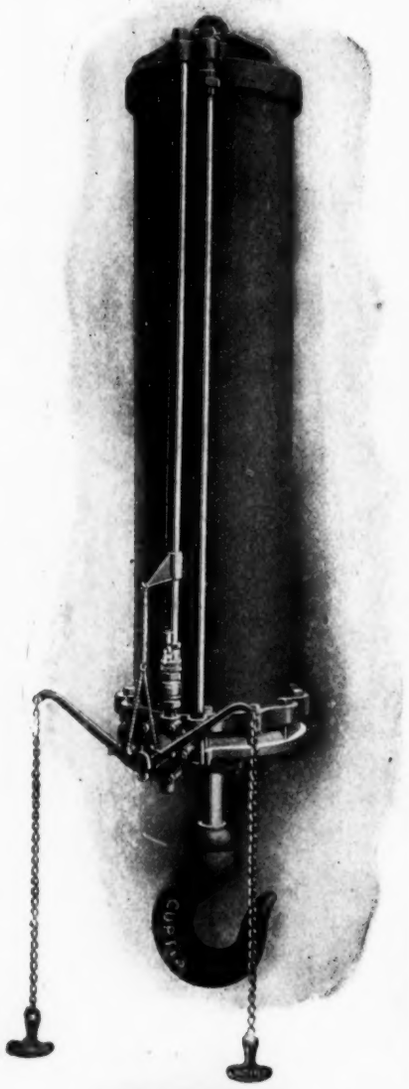

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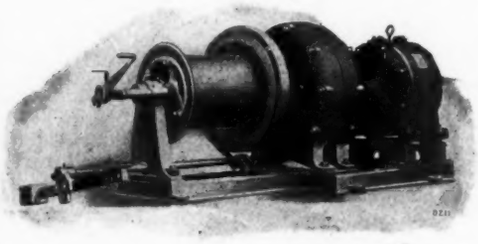

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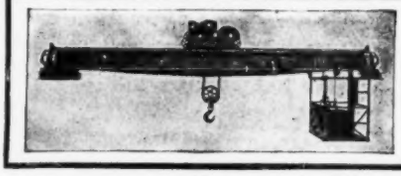

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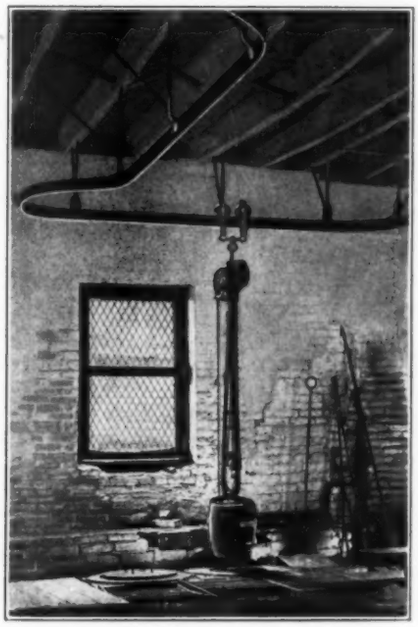

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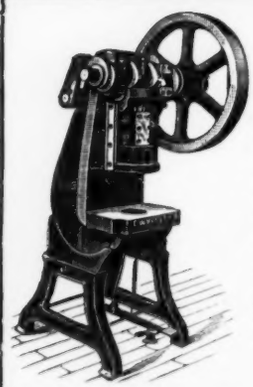

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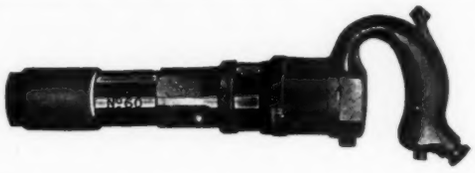

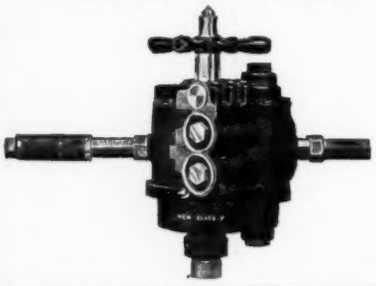

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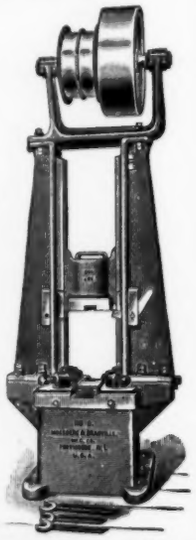

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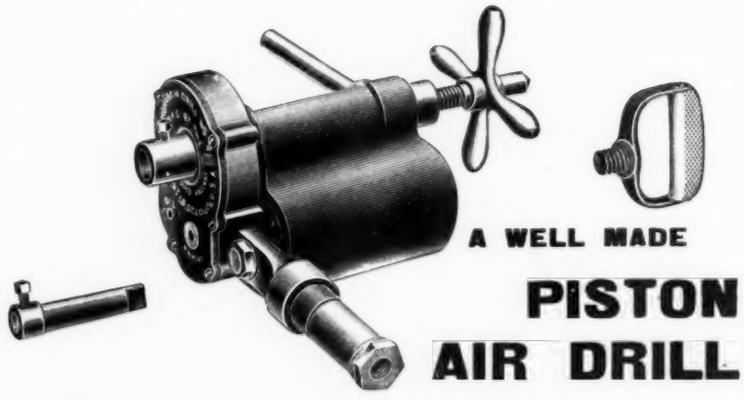

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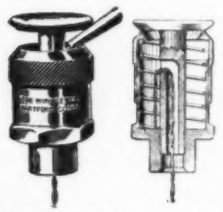

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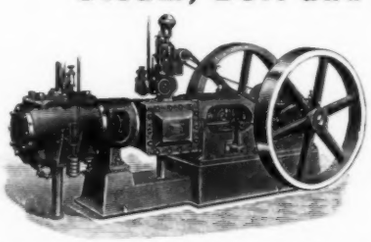

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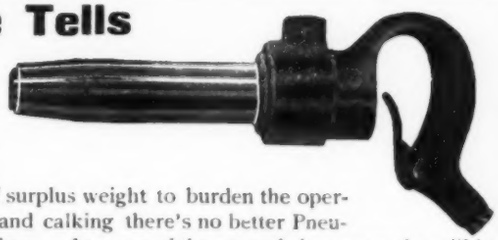

In using a "Cleveland" Pneumatic Hammer. The powerful blows prove that no air goes to waste, and it's just heavy enough to stand the racket without an ounce of surplus weight to burden the operator. For chipping, beading and calking there's no better Pneumatic Hammer in all hammerdom. Any one of the several sizes we make will be sent on trial. Write for the catalog.

CLEVELAND PNEUMATIC TOOL COMPANY,
NEW YORK PITTSBURG CLEVELAND CHICAGO

We don't ask you to buy
Q. & C. PNEUMATIC TOOLS
Because you can't get any other kind. We make no effort to control the market. What we do say is this, buy the Q. & C. line because here are the recent improvements which no discriminating buyer can afford to disregard.
Pneumatic Tools for every service fully described in our catalog. We'll send it if you like.
THE Q. & C. COMPANY,
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Of the AMERICAN MACHINIST for 1901, right up to Christmas, but if you really want one you'd better get it now. They're $5.00 each and the express charges are on you.

American Machinist, World Bldg., **New York**

Pneumatic Riveting and Chipping Hammers

Powerful. 7/8" rivets, 8 seconds. 1¼" rivets, 14 seconds.
Simple. One valve. Two moving parts.
Durable. Strong construction. Wearing parts replaceable.
Pistol Grip. Index finger instantly gives perfect control of blow.

To be convinced let us send you one on trial.

Also Electric Portable Drills, Rope Driven Portable Drills, Boiler Shell Drills.

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Dies
Special Machinery For Sheet Metal Work
Full Line of Patented Can Making Machinery
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A Study, With Tests, of Dixon's Flake Graphite.

By Professor W. F. M. Goss, Dean of the School of Engineering and Director of the Engineering Laboratory of Purdue University, Lafayette, Ind.

After a very long and severe series of experiments with pure flake graphite, Professor Goss considered it safe to conclude that no journal is likely to be damaged from overheating, or from kindred causes, in the presence of an abundant supply of Dixon's Flake Graphite.

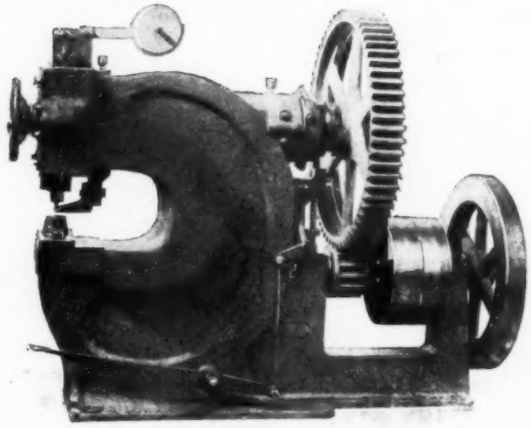
Dixon's Flake Graphite enters every crack and pit which appear in the rubbing surfaces and fills them. If the surfaces themselves are ill-shaped or irregularly worn, the graphite fills in and overlays until a new surface of more regular outline is produced. Thus it is that when graphite is applied to a well-fitted journal and its box, the rubbing surfaces are coated with a graphite layer so thin as to appear hardly more than a slight discoloration, and the brighter the original finish of the metal surfaces the thinner will be the layer of graphite. If, on the other hand, the parts are poorly surfaced or poorly fitted, a veneering of graphite of varying thickness—which in the case of a certain experiment was found as great as a sixteenth of an inch—will result. Whether thick or thin the character of the graphite veneering is always the same: Dense in structure; capable of resisting enormous pressure; continuous in service, without apparent pore or crack, and presenting a superficial finish which is wonderfully smooth and delicate to the touch.

All these are characteristic results following the use of Dixon's Graphite as a lubricant. They present themselves in a most striking manner when graphite is used alone, but they appear in the same form when graphite is applied intermixed with oils or greases.

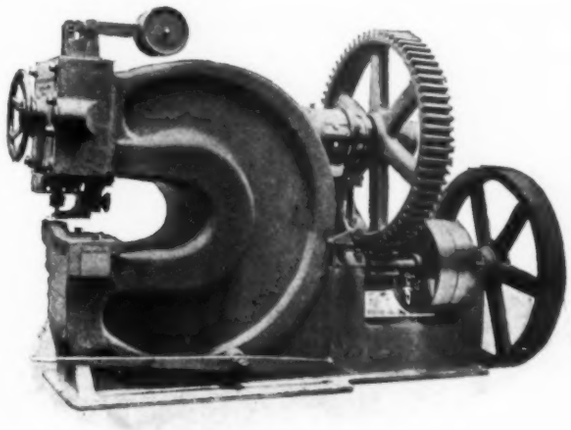
To those who are not already familiar with the advantages of Dixon's Flake Graphite, as a lubricant, we shall be pleased to send descriptive pamphlet, together with samples.

JOSEPH DIXON CRUCIBLE CO.,

JERSEY CITY, N. J., U.S.A.



No. 5. 18" Throat—1" through ⅞".
Made in Five Sizes.



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Made in Six Sizes.

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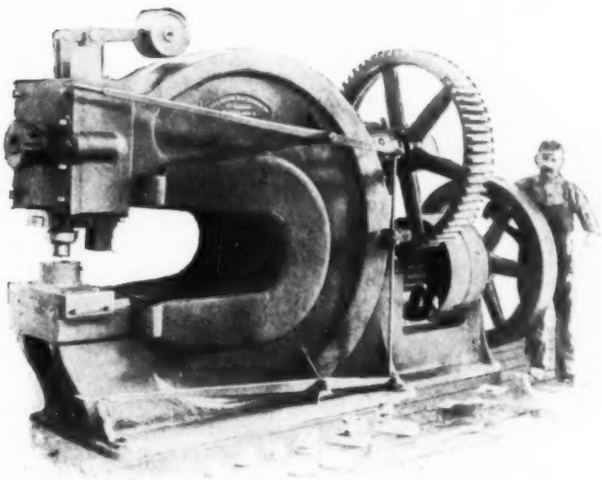
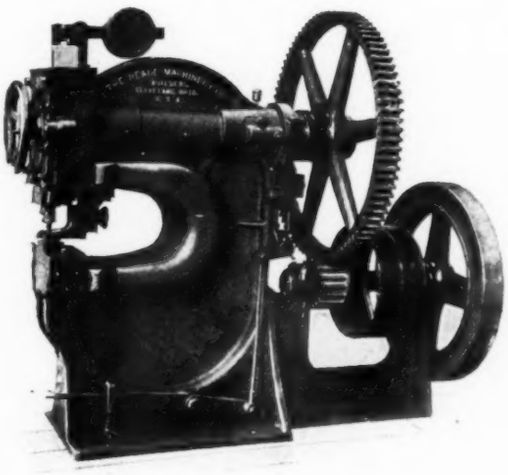


CLEVELAND, OHIO.

No. 9. 42" Throat Punch and Shear. Capacity, 4" through 1".
Made in Four Sizes.

BUILDERS OF PUNCHES AND SHEARS.



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Made in Four Sizes.

ALLIGATOR SHEARS.

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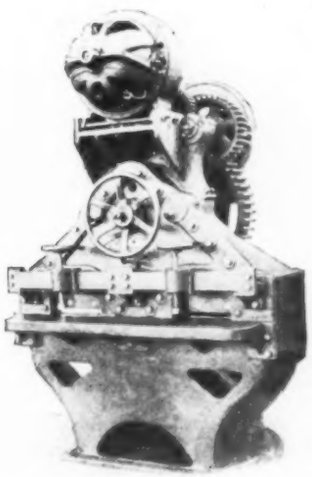

Double Angle Shear.
Two Sizes.

Hand Work Is Costly Every Time And All The Time.

You don't plane by hand or drill by hand, so why do you file by hand when

The Hartford Bench Filing Machine

will do nine-tenths of your filing, do it better and in just a fraction of the time required by the old tedious hand file?
It takes a space only six inches square, stands on the bench alongside of your workmen and gives the file 1600 strokes a minute to their—well you know how many they give along four o'clock in the afternoon.

It isn't going to cost you much and our circular matter will stand you in just a penny postal card. Send it to-night. **$28.00/100**

Kinsey-Burt Company,
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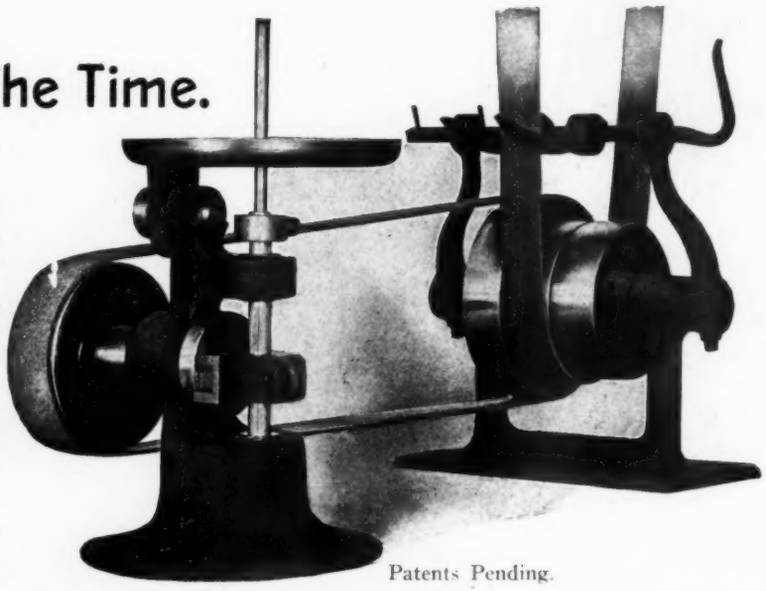
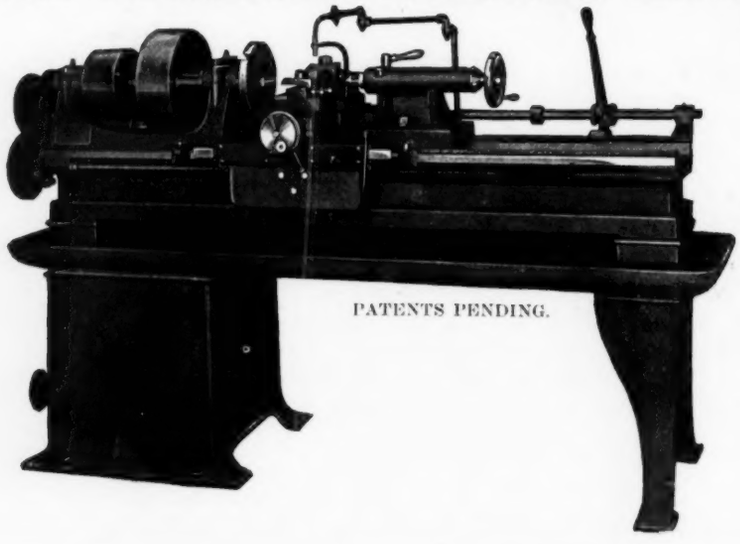


Patents Pending.

THE AUTOMATIC THREADING LATHE FOR Worms AND Screws

OF ANY SIZE AND PITCH UP TO 6-in. Dia. and 6-in. Lead.



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We guarantee this machine to do this work ACCURATELY and in less time than same can be done BY ANY OTHER KNOWN METHOD.

SEND SAMPLES, PRINTS OR SPECIFICATIONS FOR
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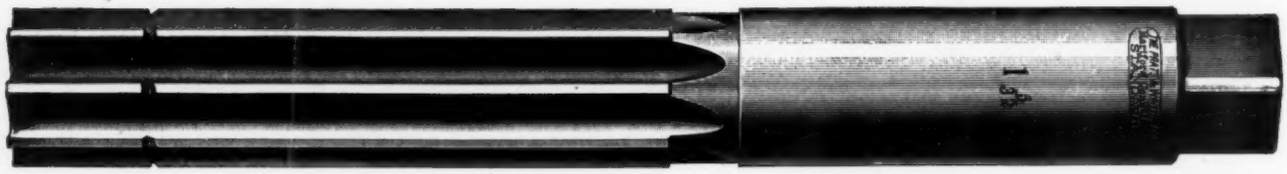

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Patent Eccentric Relief gives a Smooth Glass Surface.

Small Tool Department. **HARTFORD, CONN.**

Send for New Small Tool Catalog A to 136 Liberty Street, New York.

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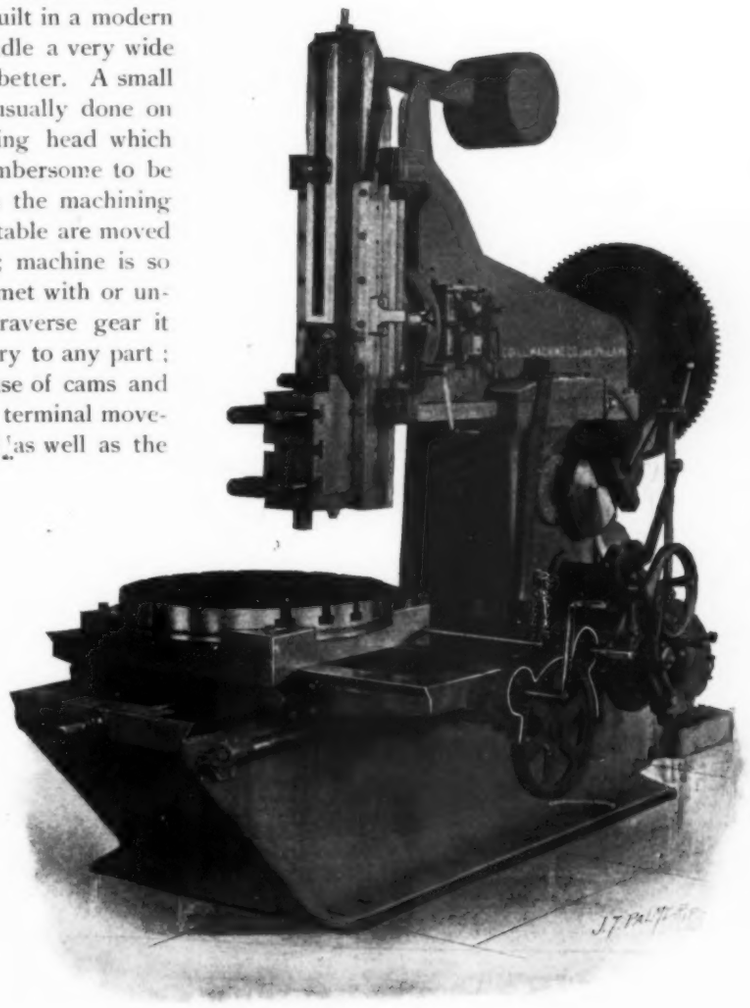
THE DILL SLOTTER

Belt- or Electrically-Driven.

This is a slotter that is different ; in this difference lies its value to you in the handling of slotted work. It is brand new, is newly designed and built in a modern way from the ground up. It will handle a very wide range of work, will handle it faster and better. A small Dill Slotter will handle much work usually done on larger ones; this comes thro' a traveling head which can be fed along when work is too cumbersome to be fed in the ordinary way ; it also allows the machining of large circles ; head and compound table are moved by power thro' a quick traverse gear ; machine is so arranged that should obstructions be met with or undue resistance in the feed or quick traverse gear it will throw itself out of gear without injury to any part ; intermittent feed is made without the use of cams and gives a quick feed with slow initial and terminal movements ; this feed operates on the head as well as the table and in all directions ; quick return saves time at each end of stroke ; 15" machine will cut to the center of a 72" circle, or to the outside of a 90" circle.

Fully described in literature which it is our pleasure to send on request.



T. C. Dill Machine Co.

Philadelphia, Pa., U.S.A.

Announcement of Perfection

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Speed Changing Pulley.

ONE HUNDRED of various sizes placed under various severe conditions and run for ONE YEAR for the purpose of proving their durability. Perfect satisfaction resulted in every case.

No effort made to sell pulleys during period of test.

Now prepared to fill orders promptly and GUARANTEE perfect satisfaction.

Remember the Speed Changing Pulley is *self contained* and can be placed on any countershaft in the space formerly occupied by the cone.

Adaptable for all purposes where a change of speed is required.

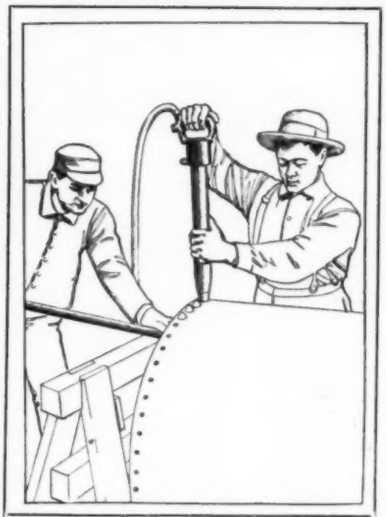
MERITS.

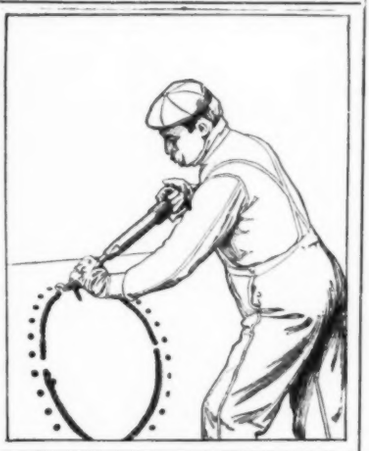
Large range and quick action. Self contained. Takes up small space. Simple, durable and of perfect construction. No machine tool is complete without it.

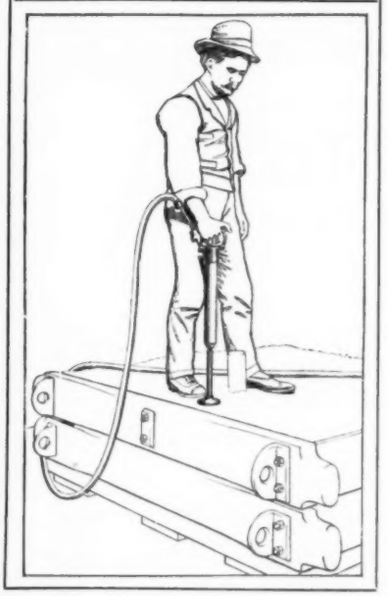
Circulars and testimonials furnished on application.

Speed Changing Pulley Company,

740-750 E. Washington St., Indianapolis, Ind., U.S.A







The Pneumatic Tools For Steady Work

THE force of Pneumatic Hammers is so great that in most makes it uses up the hammer itself. The way ordinary pneumatic hammers get "knocked out" and laid up for repairs has come to be a joke—not much enjoyed, however, by those who have to depend on such tools to get work done.

Keller Pneumatic Tools

are not in the same class with any other make. The difference is not merely in their being better made. The construction and action of Keller Hammers are such that the force of the blows does not react on the tool or the operator. For this reason they are "out of sight" of other pneumatic hammers, not only in speed and efficiency, but also in durability and ease of handling.

The best shops everywhere are using Keller tools. If you use inferior makes, how can you compete with them?

Send for our new catalogue. It is full of good ideas for using pneumatic Chipping and Riveting Hammers, Rotary Drills, Foundry Rammers, Yoke Riveters, etc.

Philadelphia Pneumatic Tool Company

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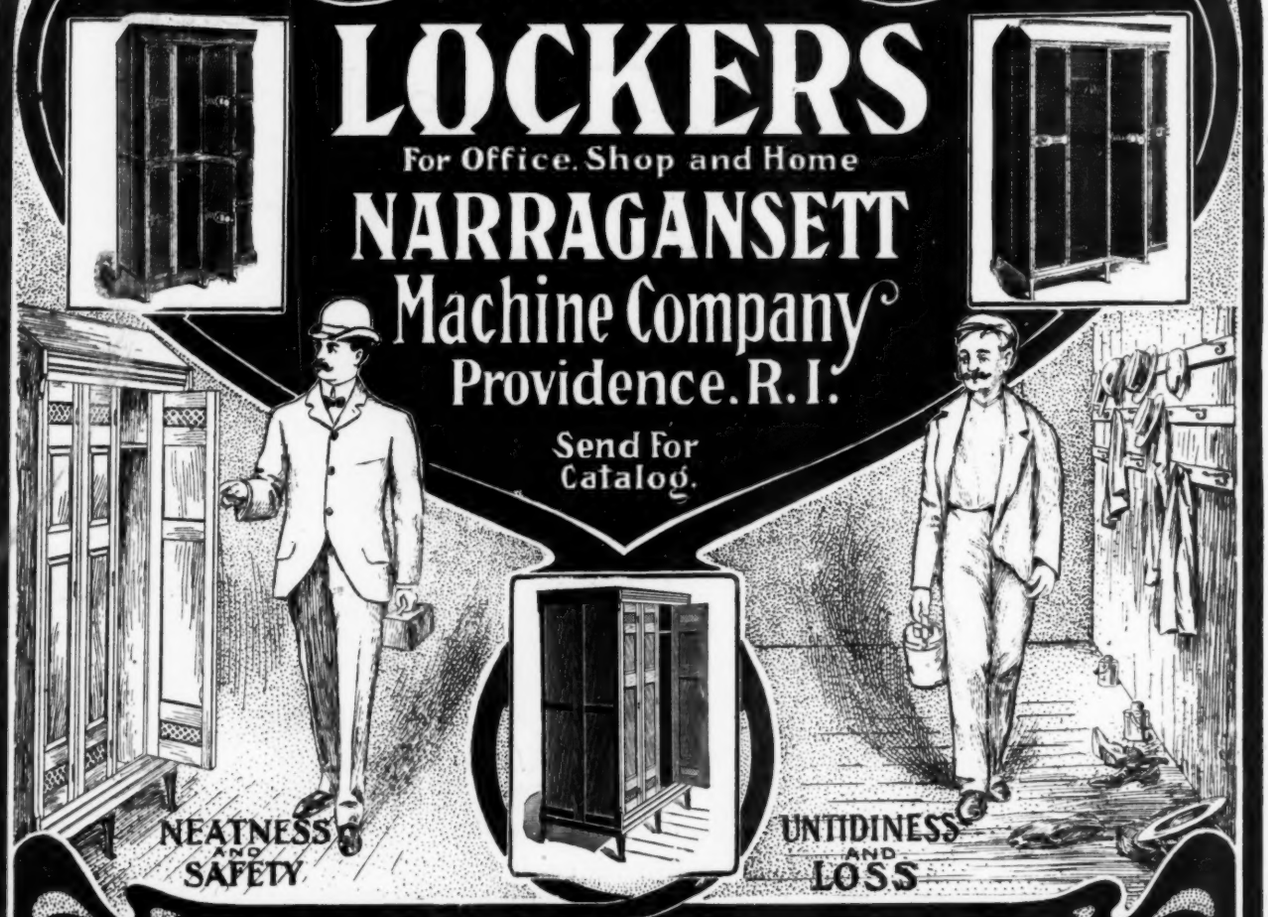
Wood and Metal LOCKERS

For Office, Shop and Home

NARRAGANSETT Machine Company Providence, R. I.

Send For Catalog.



You Won't Tolerate Carelessness In Your Work,

but do you know that carelessness is instilled into the nature of men who are forced to be untidy in their dress? Good workmen are not "dudes," but if men are taught to be neat and particular about their personal belongings, the effect will be apparent in the neatness and cleanliness of the work they do. Help your men to neatness by installing suitable lockers for their clothes. We have made a specialty of lockers for shops and can give you any style you want. We have lockers to meet every reasonable condition of space, cost, durability, accessibility for inspection, etc. You will find them in our catalog. Let us send it?

American Machinist

Save the Machine Work

Have it Cast

There is no mystery about it. We are doing it every day. It is simply the casting of articles finished. Argument seems quite unnecessary. Its utility is self-evident. And if it is possible to produce a thing by the one operation of casting, why go further? We admit that to the uninitiated the scheme seems impracticable, but we have been at it a number of years now. These cuts show some of the many parts cast and used without machining, and the accuracy equals the finest tool work. The United States Government has recognized the instructive importance of the work as representing mechanical development, by placing a line of samples on exhibition in the United States National Museum.

For further information and samples address:

Franklin Mfg. Co., Syracuse, N. Y.

Is Your Draughting Satisfactory?

If not, are the men to blame, or their facilities? Good work can't be done on a shoe box, and the most accurate work requires the most carefully made tables. These you will find are

Fry's Patent Draughting Tables.

They are made in the best possible manner and of the best stuff. Frames are of good grey iron, thoroughly braced and bolted together and finished in black enamel. The tops, or drawing boards, are of the best quality Michigan white pine, kiln-dried and fitted together in 4 inch strips in such a way that they can't warp and can't come apart. Prices are very low, considering quality and goods are shipped carefully packed to prevent damage in transit.

SEND FOR OUR COMPLETE CATALOG.

J. C. Alexander Mfg. Co.,

Grand Rapids, Mich., U. S. A.

A Positive Speed Ratio

That can't vary, secured by a mechanism that can't slip, is what is afforded by

The Morse Silent Running Chain

The reason for its success may be found in the Morse Frictionless Rocker Joint which consists of two pieces of hardened tool steel so shaped and arranged that, as the joint works, while passing on and off the sprocket, one piece rocks or rolls on the other.

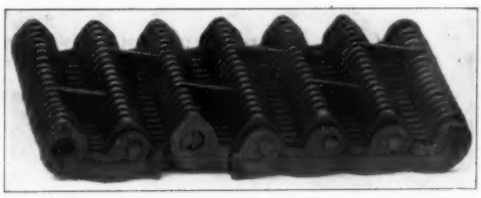
The motion of this chain joint is therefore a rolling one and as there is no wearing slide, lubrication at this point is unnecessary.

There is absolutely no lost motion in these chains and all possible wear is compensated for by the peculiar shape of the links.

The Morse Chain may be used wherever belting or gearing is, and in some places where neither of these means is satisfactory.

If you have any belt or gear troubles it will pay you to get the interesting book we are sending out.

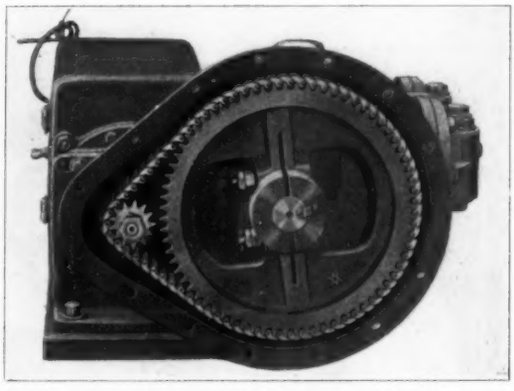
The Morse Chain.



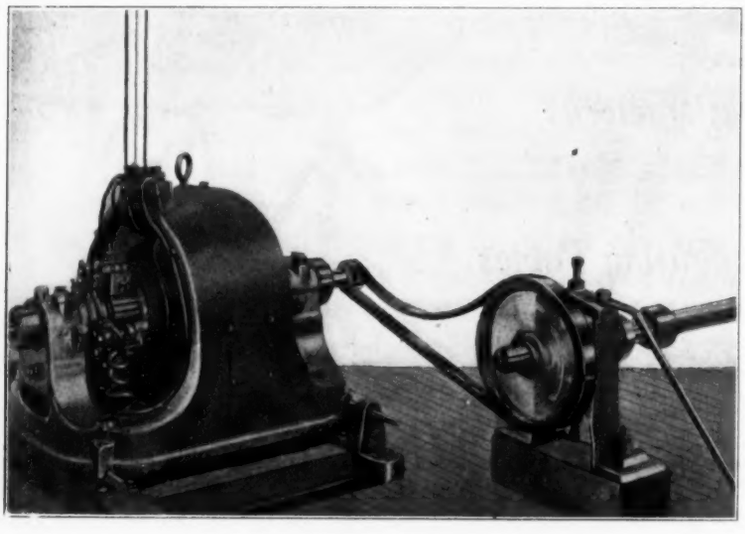
The Frictionless Rocker Joint

The Chain Drive Complete,

Showing Chain when Running.

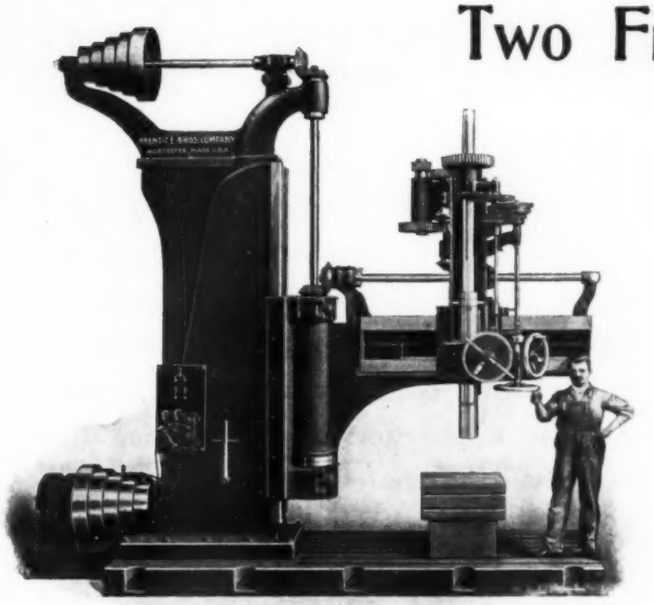


One of a Hundred Applications.



Morse Chain Company,

Trumansburg, N. Y.



Two Friction Clutches

on the shaft of this Electrically Driven Radial Drilling Machine, controlled by a lever, enable the operator to start, stop or reverse, and at an accelerated speed, independent of the motor; and the spindle is back geared, counterbalanced and has an improved quick return and stop motion, permitting spindle to be quick returned or approached while power feeding, and allows point of drill to be brought to the work and power feed thrown in by the same lever while machine is in operation.

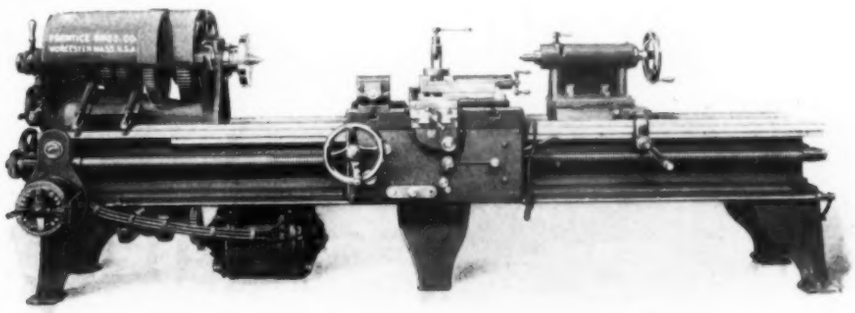
We make all our Power Feed Drilling Machines with these devices and will be glad to send you full particulars, if interested.

This 24-Inch Swing Engine Lathe,

Electrically Driven, is without an equal. It has the power cross feed and eight even changes of spindle speed, from 4 to 284, back geared. Also has hollow steel spindle, hard bronze bearings; end thrust of the spindle sustained by a step, independent of the bearings, belt and gear feed, and a number of other points which we tell you about in our circular.

PRENTICE BROS. COMPANY,

Worcester, Mass.

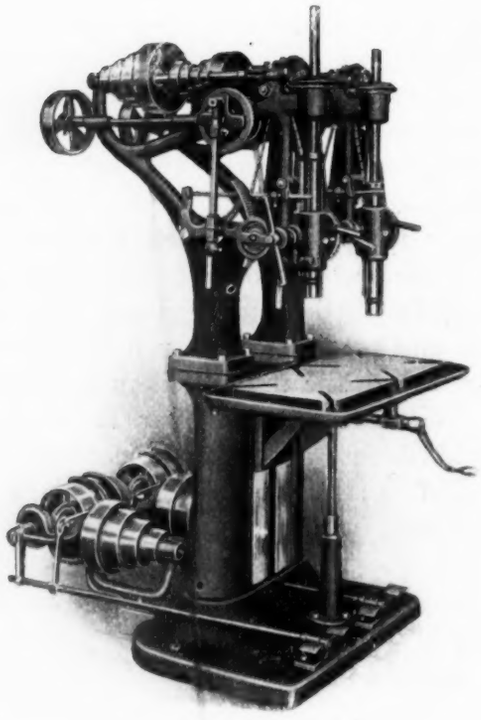


Builders of

Upright, Radial, Vertical, Gang, Suspension and Boiler Makers' **Drilling Machines**

and **Engine Lathes,** 12 to 26-inch swing

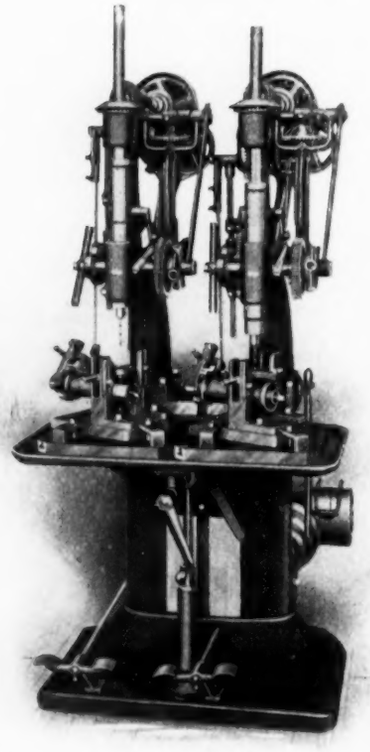
New Manufacturers' Drill



Two-Spindle Drill.

This is a B. F. Barnes product. It has had design and making to meet the needs of those who have large numbers of multiple holes to be drilled. It is so made that all drilling operations are controlled by one lever. This lever starts the drill, which goes to the work, feeds thro' the work and returns immediately without further manipulation. These drills are made with two, three or four spindles and will handle work as fast as the operator can place it in jigs. The use of these drills brings immediate gains thro' their ability to handle much work in a very short time and in a very accurate manner.

These drills should have your very careful consideration. All details are sent on request.



Two-Spindle Drill Fitted with Jigs for Drilling Whiteside Metal Wheel Hubs.

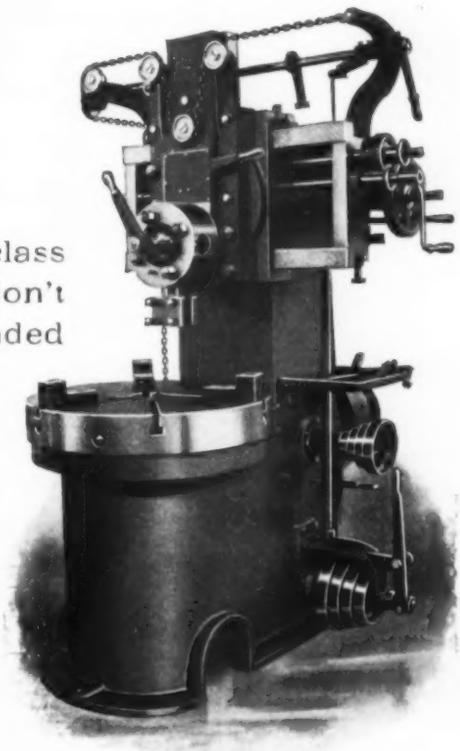
B. F. Barnes Co.,

Rockford, Illinois, U.S.A.

The Whiteside Metal Wheel. Hubs Drilled Automatically by our Drills.

Either Or Both Of These Mills

Will prove a good investment in any first-class shop. They are the kind of tools that don't depreciate in value and that may be depended on for good work and a continuation of it for years. Both are made by the Rogers Machine Tool Co. That's sufficient guarantee of the quality and you have our warrant besides. You know some makes of tools always have a high second-hand value. This is the kind and we'd like to tell you why it is.



31-Inch Boring and Turning Mill with Swivel Turret Head.

52-Inch Two Head Screw Cutting Mill.

This 31-inch Mill is compact, simple and easy of operation. Weighs 5600 lbs., and requires a floor space of but 44 x 77 inches capacity; swings 31 inches; takes under rail 14 inches. Built in other sizes and fitted with either belt or motor drive.

The 52-inch Two Head Screw Cutting Mill is for big work. Weighs 17000 lbs. and covers a floor space of 92 x 101 inches; swings 52 inches in the rough and takes 40 inches under the rail.

WRITE US YOUR TOOL WANTS.

Prentiss Tool & Supply Company,

115 Liberty Street, NEW YORK.

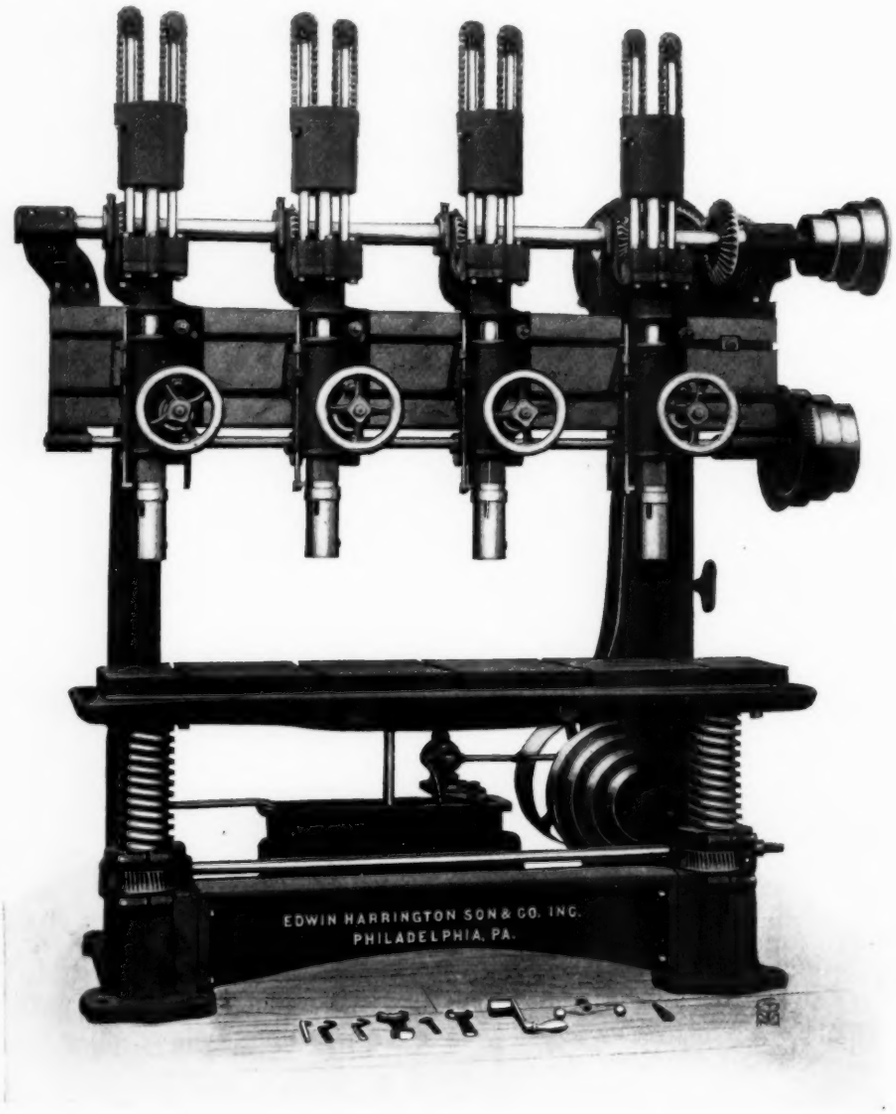
Buffalo: 507 D. S. Morgan Building. **Boston: 200 Franklin Street.** **Pittsburg: 120 First Avenue.**

We represent the following machinery manufacturers:

Cincinnati Milling Machine Co., plain and universal millers.
Cincinnati Machine Tool Co., 21 in. to 42 in. upright drills.
Lodge & Shipley Machine Tool Co., 14 in. to 60 in. lathes.
L. W. Pond Machine & Foundry Co., 16 in. to 72 in. planers.
Rogers Machine Tool Co., 31 in to 62 in. vertical boring mills.
B. F. Barnes Co., screw cutting engine lathes and drills.
Cincinnati Planer Co., 24 in. to 60 in. planers.
Perkins Machine Co., presses.
Bickford Drill & Tool Co., radial and multiple drills.
Diamond Machine Co., grinding machines.
Fay & Scott, engine and pattern-makers' lathes.
Binsse Machine Co., horizontal boring machines.

and many others. We always have in stock, second-hand tools, many of which are practically "good as new," and publish a list weekly, in this paper.

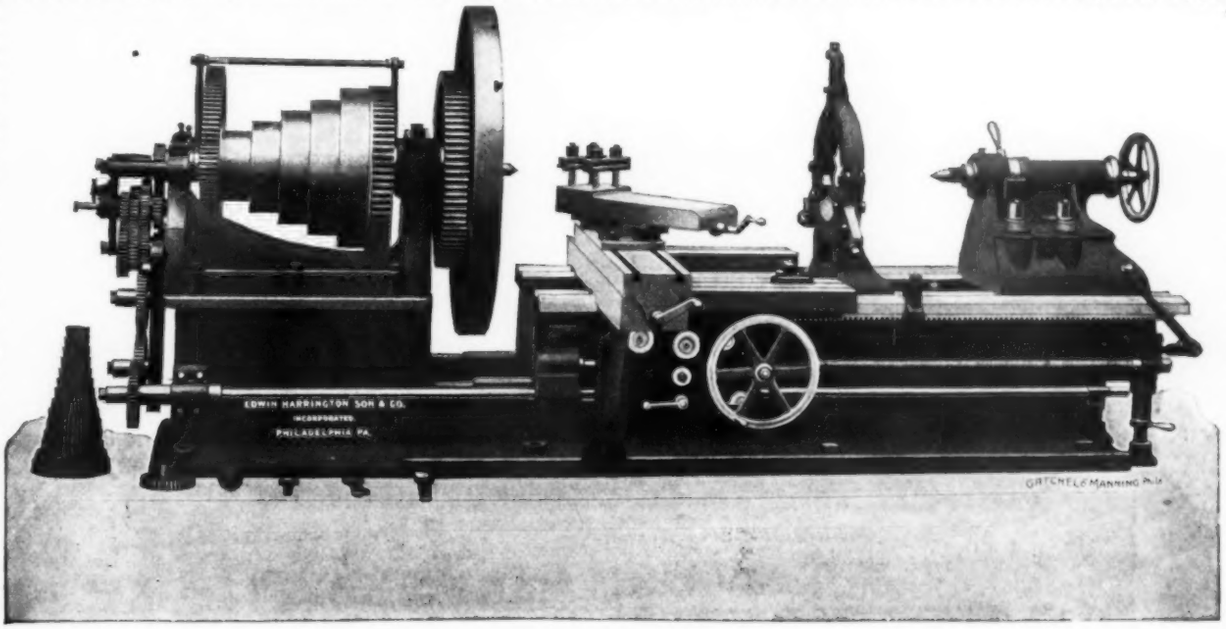
The Harrington 4-Spindle Multiple Drill for the drilling of anything from a simple plate to a locomotive frame, quickly and accurately, one hole or all at a time. This is a drill of more drill conveniences than any other similar one built.



Some few points of merit are: steel spindles; spindles counterbalanced; quick return; oil reservoir on end insures lubrication of washers; feed of spindles stopped automatically and at any point within traverse; three changes of feed; table has oil gutter and is raised and lowered by worm and worm gear; in short, embodies every last feature that can serve a useful purpose, and utterly devoid of any trappings or foolishness of any kind. Fully described in catalog, which it is our pleasure to send.

Edwin Harrington, Son & Co., Inc.,

Machine Tool Builders, Philadelphia, Penna., U.S.A.



Extension Gap Lathes

Made in Four Sizes—25-in. and 39-in.—28-in. and 48-in.—36-in. and 60-in.—48-in. and 72-in. Swings.

Has special value in the jobbing or repair shop. This is not to be confounded with the ordinary Gap Lathe where the width of the gap is fixed. This lathe is so made that gap can be made larger or smaller as will best serve the work being done upon it. Has extra heavy bed, forged crucible steel spindles, phosphor bronze boxes, has three changes of feed thro' cone feed gears without change; tail-stock has set-over for taper work, dead spindle clamped by adjustable conical binder. This is a lathe of much worth and should have your careful consideration.

1,000 lbs to 4,000 lbs.
Other sizes up to 20,000 lbs.

The Keystone Spur-Geared Chain Hoist

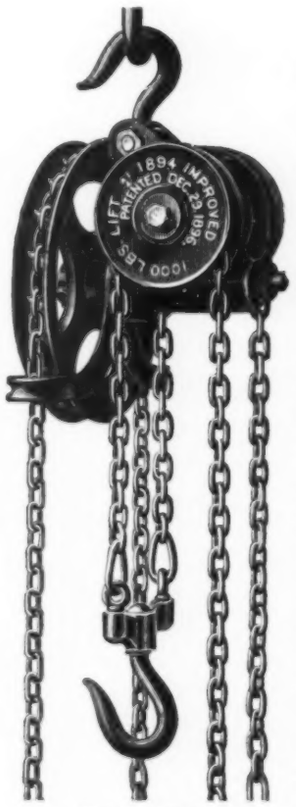
A Chain Hoist pleasingly peculiar; its special features being true mechanical design and highest efficiency. Built from the best of material by the best of workmen. So built that it will last forever, work smoothly at all times, never go loose or go contrary, and tested and proven in every part before it leaves our shop. Details on request.

The Harrington Improved Screw Hoist

Some people like Screw Hoists. Here's one that is just a little better than the best of others. It's one of those hoists that's practically indestructible. Use it roughly if you have to, it'll stand the strain. It's made to last, to do its work latterly as well as in the first instance. There's no necessity for tinkering, no weak parts to watch and to be renewed from time to time. Is always ready, always willing; doesn't cost too much and is a good investment. Details on request.

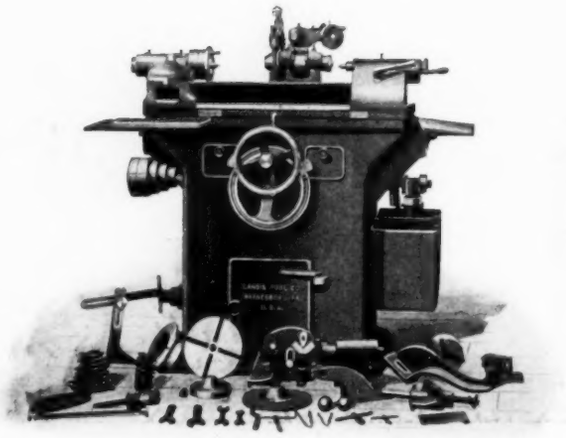
Edwin Harrington, Son & Co., Machine Tool Builders,

Philadelphia, Pa., U.S.A.



The Harrington Improved Screw Hoist.

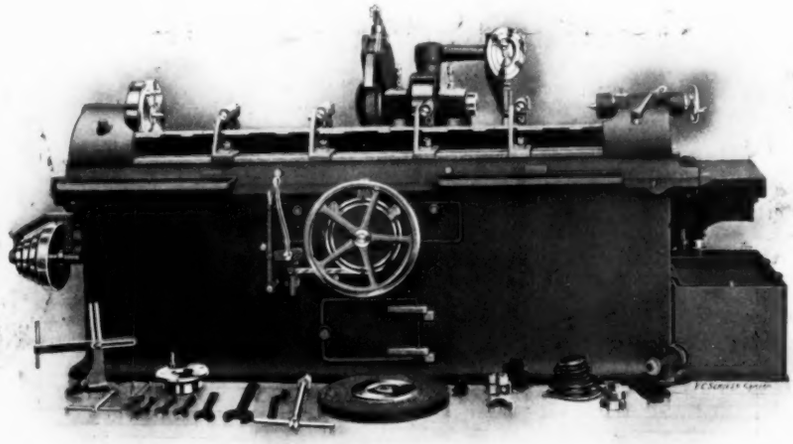
Here's A Couple of The Machines



No. 1 Landis Grinder.

made by Landis, for finishing work by grinding. The finishing of work by grinding is the recognized modern method and carries a degree of accuracy not obtainable in any other way. Landis Grinders stand at the head of all grinding machinery and are made in a grinder shop, by grinder experts, from start to finish. They are the result of some years of practical experience and actual work along grinding lines.

The advantages of finishing work by grinding are many. Work finished on a lathe is never quite accurate—the idea is wholly wrong—the friction of the cutting tool heats the work and warps it from accuracy—the lathe or file leaves high spots or bumps on a shaft due to the heterogeneous nature of the material; while in many instances, not enough to make a great difference; the lathe scheme is wrong and not only wrong, but more costly. A grinding machine, and particularly a Landis Grinder, keeps work cool thro' the liberal use of water. The grinder product, if it be cylindrical work, is absolutely round; if flat work, it is positively flat. The work is handled faster by grinding, everything stands in favor of grinding, and Landis Grinders represent the best in grinders, so that an equipment of Landis Grinders means faster work, better work and increased gain. We've a very interesting book on grinding, quite exhaustive in its treatment of the subject—book is free.



No. 16 Landis Grinder.

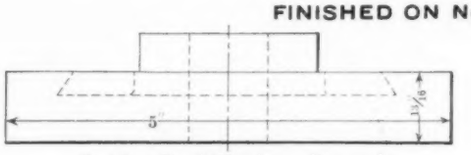
Landis Tool Co., Waynesboro, Pa., U.S.A.

AGENTS—Walter H. Foster, Manager, New York and Boston. Hill, Clarke & Co., Boston and Chicago. Brown & Zortman Machinery Co., Pittsburgh. Marshall & Huschart Machinery Co., Cleveland and Cincinnati. C. W. Burton, Griffiths & Co., London. Ad. Janssens, Paris. Schuchardt & Schutte, Berlin, Cologne, Vienna, Brussels, Stockholm and St. Petersburg.

Here're Examples of The Work

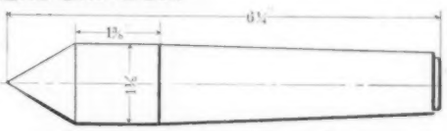
done by Landis Grinders, with the time it took to complete shown. These are shown merely to afford an idea of the range of the work and as suggesting possible uses to you.

FINISHED ON No. 3 UNIVERSAL GRINDER.



Cast Iron Hand Wheel. .010 Removed from Face and Side in 6 Min.

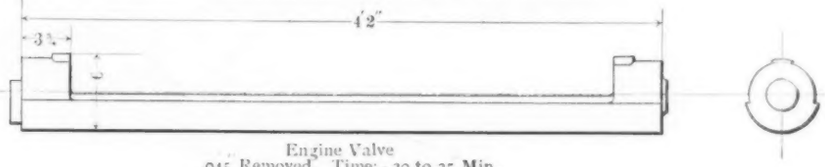
No. 3 Mach.



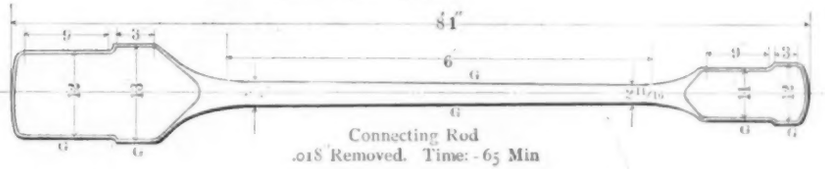
Cast Steel. .010 Removed all over and Taper fitted in 12 Min.

No. 3 Mach.

FINISHED ON No. 8 GRINDER.

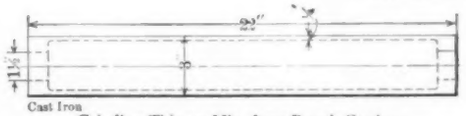


Engine Valve
.045" Removed. Time:-20 to 25 Min.
.020" Removed. Time:-10 Min.



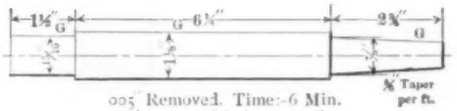
Connecting Rod
.018" Removed. Time:-65 Min

FINISHED ON No. 11 GRINDER.

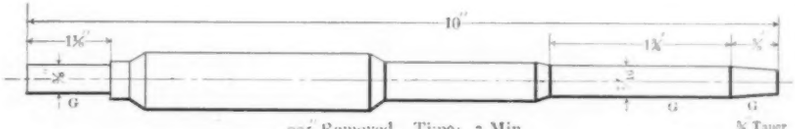


Cast Iron
Grinding Time 20 Min. from Rough Casting.
Reduced 1/8" Diameter. Accuracy Limit .002"

No. 11 Mach.

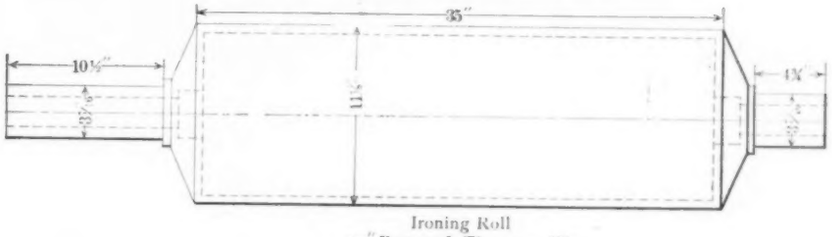


.005" Removed. Time:-6 Min.
Accuracy Limit: .00025"



.005" Removed. Time:-3 Min.
Accuracy Limit. -.00025"

FINISHED ON NO. 16 GRINDER.



Ironing Roll
.025" Removed. Time:-40 Min.

Landis Tool Co., Waynesboro, Pa., U.S.A.

AGENTS—Walter H. Foster, Manager, New York and Boston. Hill, Clarke & Co., Boston and Chicago. Brown & Zortman Machinery Co., Pittsburgh. Marshall & Huschart, Machinery Co., Cleveland and Cincinnati. C. W. Burton, Griffiths & Co., London. Ad. Janssens, Paris. Schuchardt & Schutte, Berlin, Cologne, Vienna, Brussels, Stockholm and St. Petersburg.

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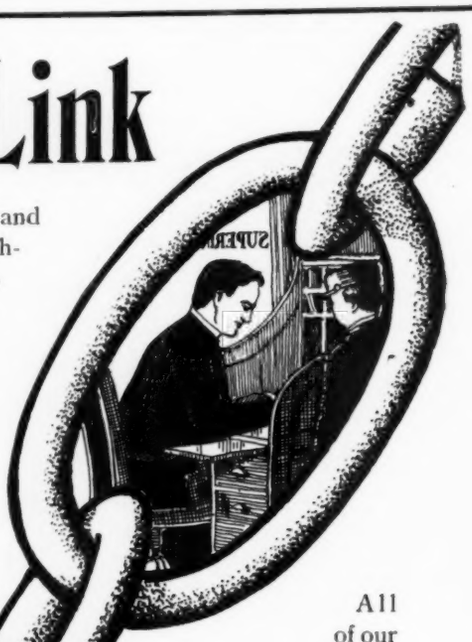

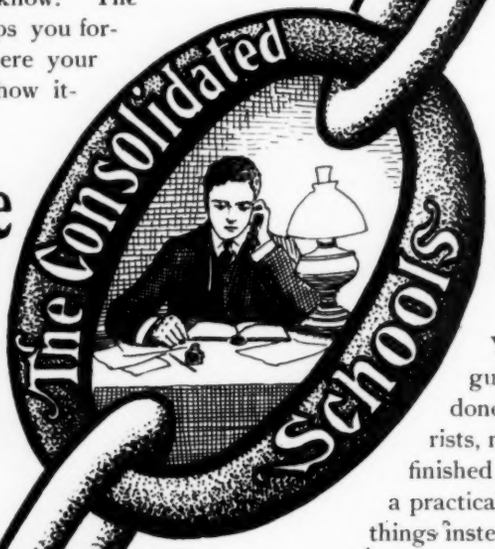

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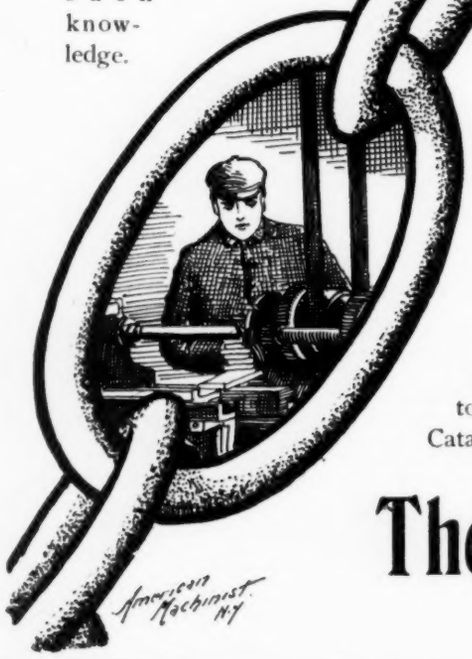
of their chosen subjects. You have the advice and guidance of those who have done practical good, no theorists, no riders of hobbies; your finished course leaves you with a practical knowledge of everyday things instead of a lot of inaccuracies which you have to forget and start back when meeting actual work.



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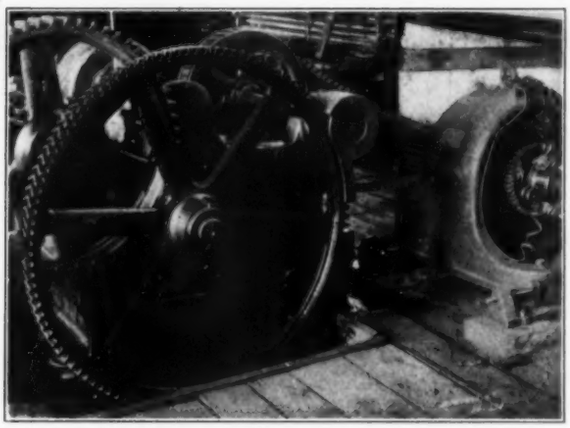
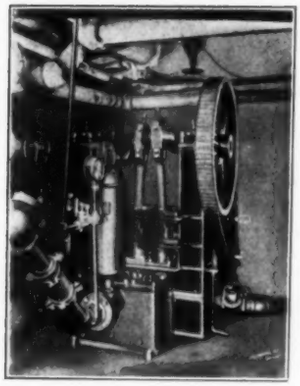
Strong as the Pyramids



Silent as the Sphinx

Motor-Driven Roll Turning Lathe



12 H.P. House Pump.

SEVERAL APPLICATIONS OF THE SILENT CHAIN ARE SHOWN HERE.

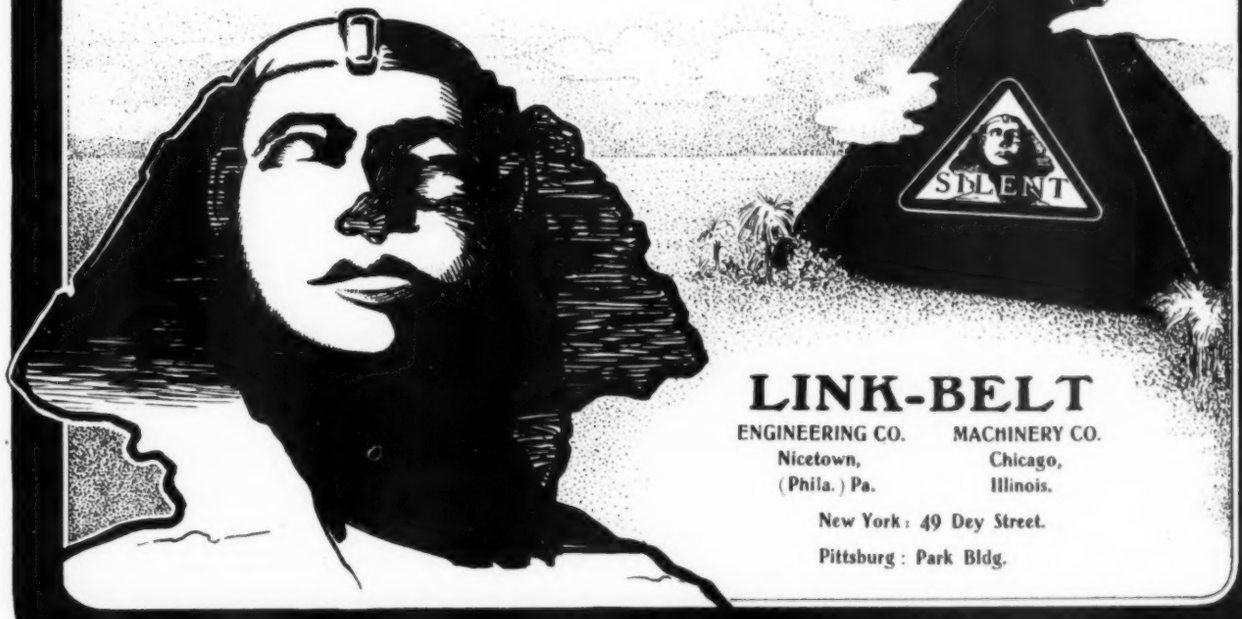
The cut above shows a motor-driven Roll Turning Lathe at the Maryland Steel Company's plant, at Sparrows Point, Md. The Silent Chain furnishes a silent, positive and efficient drive from the motor to the lathe, and it is not affected by heat, damp or oil.

View at the right shows one of three Governor Drives on the three large rail mill engines in the same plant. The Renold Silent Chain is the best selection for such a service, rendering the regulation of the engine more positive and being free from all the danger of slipping, breaking or damage by wet and oil to which a leather belt is liable.

Illustration at left shows a 12 H. P. House Pump at the Hotel Raleigh, Washington, D. C. The Silent Chain in this instance replaced a belt which was constantly slipping. It has resulted in increased efficiency and requires less attention than the belt.

These are but three of a multitude of installations. Each has solved a different problem and has resulted in giving increased satisfaction and higher duty. The Sphinx Booklet is full of instances — would you like a copy?

Governor Drive.



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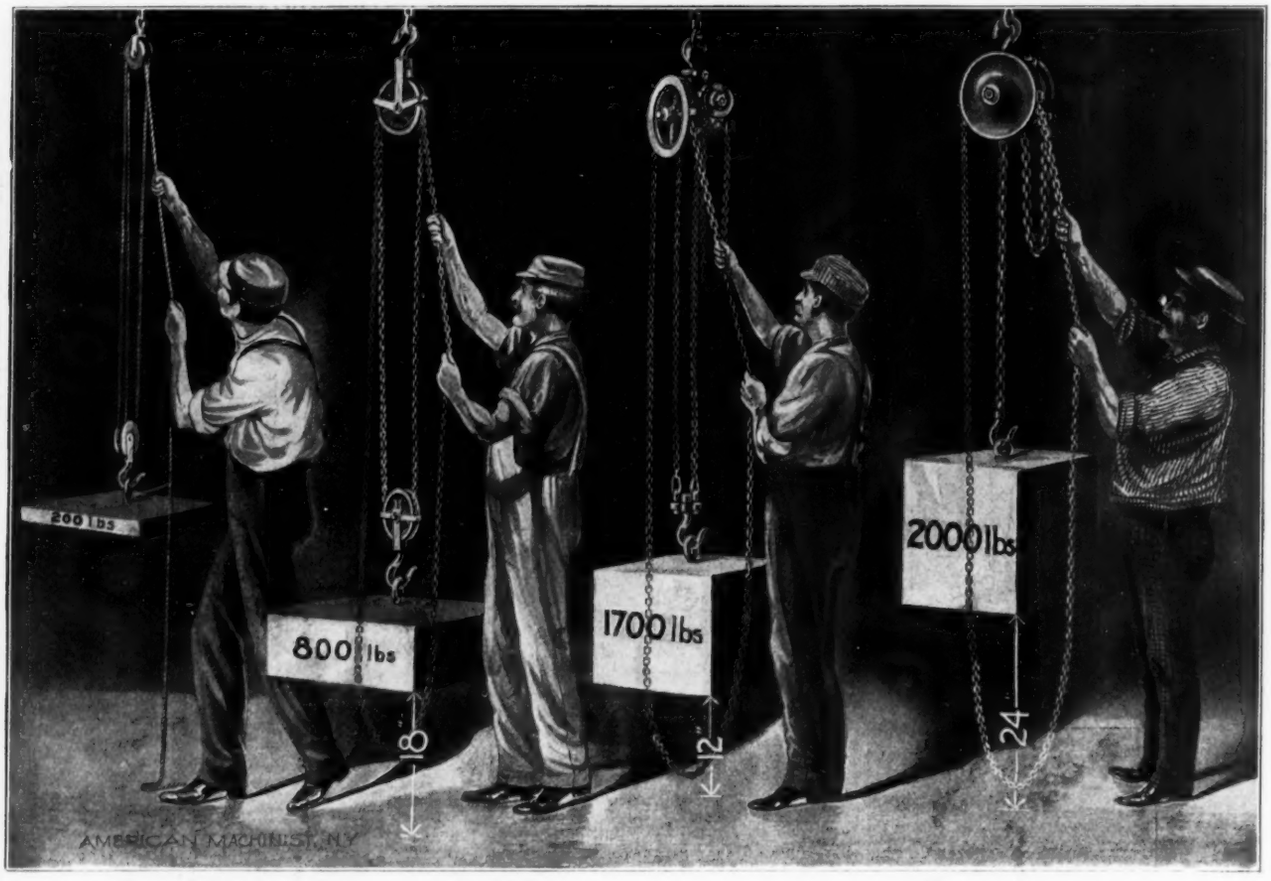


It Takes Just Half a Minute

Of actual work to demonstrate the greater ease and speed of hoisting with the "Triplex" Spur Geared Chain Hoist, as shown in the picture. This was taken from a photograph of the "Triplex" (at the right), the Duplex, the Weston Differential and an ordinary rope block after half-a-minute's hoisting, with each man exerting a force of eighty-two pounds.

The "Triplex" Spur Geared Chain Block Saves Time and Energy.

It opens up new possibilities for money saving through quicker and easier hoisting; and, used with overhead trolleys, saves the time which workmen otherwise waste in waiting for their turns at the traveling crane for transporting heavy work to waiting machines. Let us send you a "Triplex" on trial, or at least, our new 48-page catalog, just off the press. Trolleys and light travelers too.

The Yale & Towne Mfg. Co., 9-11-13 Murray St., **New York.**

LACE YOUR BELTS QUICKER AND RIGHT

12-inch Hand Belt Lacer.

Saves Time. Time's too valuable at present to be wasted in lacing belts in the ordinary way.

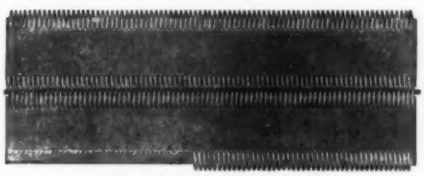
The minutes lost in fussing with leather lacing aggregate considerable time in the course of a year.

'Twere better to spend this time on more productive operations, and our Belt Lacing Machine is the means to such an end.

Saves Lacing. Belts laced in our way are laced better, they are laced quicker and they last longer.

Costs One Cent.

The cost of lacing belts in our way is next to nothing; belts up to five inches in width are laced



Here's What It Does.

in two minutes, at a cost of one cent; larger ones cost a trifle more, say a couple of cents.

Belts are laced with our Coil Clasp Lacing, costing about a third of other lacings and last ever so much longer. The belt is fastened the same on both sides and can be taken apart, if necessary, in two seconds.

24-inch Power Belt Lacer.

Between 1,700 and a couple of thousand of these machines are in use, and they are in the most progressive shops on earth—shops where the saving of time and labor has consideration.

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FOREIGN AGENTS—The Jackson Belt Lacing Machine Agency, Toronto, Canada. Selig, Sonnenthal & Co., 85 Queen Victoria St., London, Eng. New York Export & Import Co., New York City. Wilh. Sonnesson & Co., Malmo, Sweden. De Fries & Cie., Akt., Dusseldorf, Germany.

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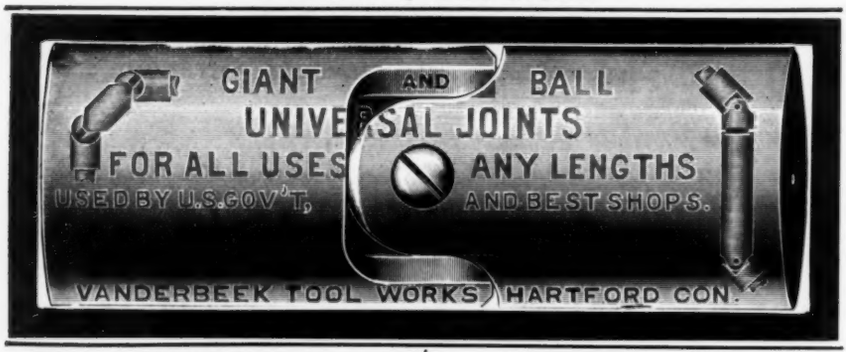

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Three 13 in. Slate Sens.	3 Spindle Sigourney
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2 Spindle Quint Drill	Garvin 1¼ & 1½ in. " "

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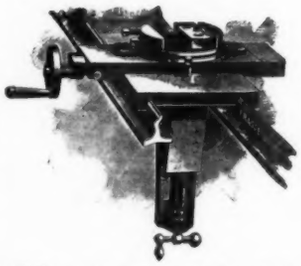

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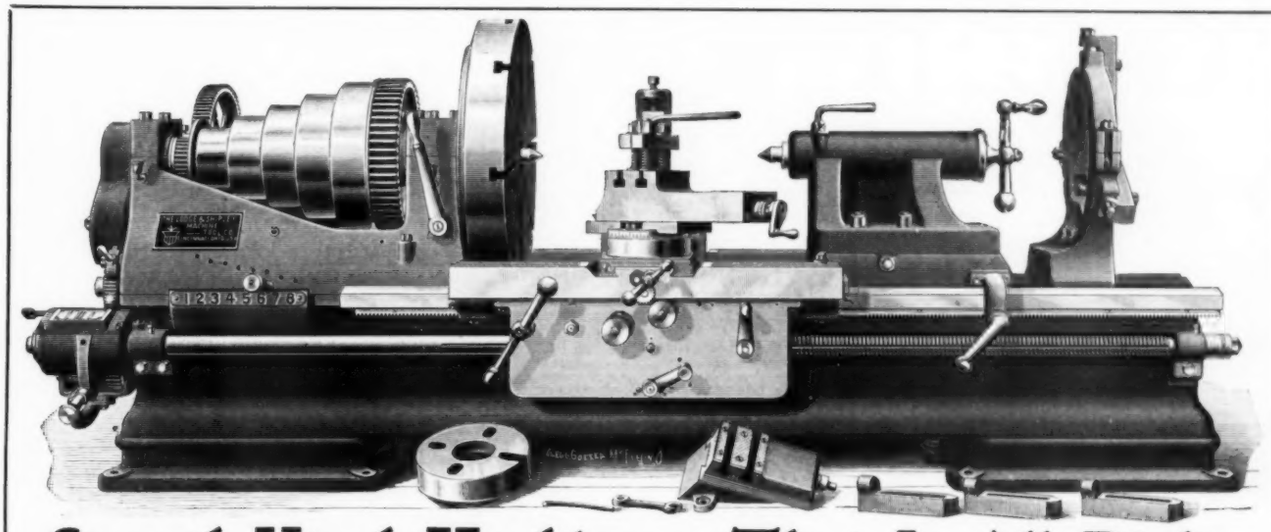
MANUFACTURERS OF
Set, Cap and Machine Screw Studs, &c.



Second Hand Machinery That Is All Right.

Lathes.

10 in. hand lathe. 11 in. Shepard.
14 in. x 4½ ft. Putnam.
14 in. x 5 ft. Lathe & Morse.
14 in. x 6 ft. Boggart, 9 in. x 25 in., foot pr.
14 in. x 6 ft. Wolcott.
15 in. x 6 ft. Wood & Light.
16 in. x 5 ft. Reed.
16 in. x 6 ft. Putnam, with chuck.
16 in. x 7 ft. Lathe & Morse.
16 in. x 8 ft. Porter.
20 in. x 7 ft. Conway.
20 in. x 8 ft. Pratt & Whitney.
28 in. x 20 ft. Harris.
62 in. x 14½ ft. New Haven, triple geared.
60 in. Pitt lathe.
22 in. combination Bullard, geared into face plate.
36 in. x 14 ft. triple geared Fitchburg.
48 in. x 22 ft. triple geared Fitchburg.
48 in. x 24 ft. triple geared Fitchburg.
16 in. x 8 ft. Goddard with compound and taper.
24 in. x 14 ft. Greaves & Klusman.
16 in. x 8 ft. Le Blond.
20 in. x 10 ft. Le Blond.
26 in. x 18 ft. Le Blond.
30 in. x 12 ft. Le Blond.
30 in. x 16 ft. Le Blond.
36 in. x 14 ft. Le Blond.
36 in. x 18 ft. Le Blond.
24 in. x 16 ft. Lodge & Shipley.
30 in. x 16 ft. Lodge & Shipley.
15 in. x 6 ft. Roach & Von Wyck.
15 in. x 8 ft. Roach & Von Wyck.

Drills.

32 in. Aurora, B. G. & P. F.
Baker Bros. F, 8 in.
Baker Bros. FII, 12 in.
Baker Bros. KIII.
22 in. Hamilton, B. G. & P. F.
24 in. Barnes, B. G. & P. F.
24 in. Schumacher, with chuck.
30 in. Davis & Egan, radial.
80 in. Dietz radial.
4-spindle Pratt & Whitney.
3-spindle Le Blond.
24 in. Sibley & Ware.
Multiple hub drill.
Sensitive bench drill.
21 in. Aurora, B. G. & P. F.
24 in. Aurora, B. G. & P. F.

Punches and Shears.

No. 2 Royersford.
No. 3 Royersford.
No. 3A Royersford.
No. 1 Werner's portable punch.
No. 3 Werner's portable punch.
No. 4 Werner's portable punch.
No. 5 Werner's portable punch.
Type "LU" Johns patent universal punch.
Werner's model "B" beam shear.
Werner's model "D" beam shear.
Johns patent T30 beam shear.
New Manville press.

Boring Mills.

30 in. Bullard.
37 in. Bullard.
60 in. Sellers.
80 in. Sellers.

Milling Machines.

No. 6½ plain Brainard.
No. 1 Brown & Sharpe universal.
No. 1 Cincinnati universal.
No. 12 Brown & Sharpe plain.
Garvin hand miller.
No. 3 Garvin hand, heavy pattern, overhanging arm.
No. 4 Garvin plain.
No. 2 Kempsmith plain.
No. 3 Kempsmith plain.
No. 10 Kempsmith hand, with vise.
Lipe universal.
Lodge & Davis universal.
Pedrick & Ayer universal (good as new).
No. 2 Pratt & Whitney hand.
No. 2 Pratt & Whitney, Lincoln pattern.
No. 3 Pratt & Whitney 2-spindle planer type, 8 ft. bed.
No. 2 Cincinnati universal miller.
No. 4B Becker vertical.

Shapers.

30 in. Fox, open side.
18 in. Flather crank.
Fitchburg traveling head shaper.
16 in. Gould & Eberhardt.
20 in. Gould & Eberhardt.

Planers.

16 x 16 x 18 Crank.
20 x 20 x 4 Wood & Light.
26 x 20 x 4½ planer.
26 x 26 x 6 Wheeler.
28 x 28 x 7 New Haven.
36 x 33 x 8 Screw drive.
36 x 36 x 12 Fitchburg.
36 x 36 x 10 Cincinnati.
24 x 24 x 6 Pond.
30 x 30 x 8 Cincinnati.

Screw Machines.

No. 1 Brown & Sharpe automatic.
14 in. Brown & Sharpe turret.
¾ in. Cleveland automatic.
2 in. Cleveland automatic.
1⅜ in. Hartford automatic.
18 x 6 Davis & Egan.
No. 1½ Dreses & Mueller.
Garvin hub machine.
No. 2 double spindle Hartford automatic.
19 x 6 Lodge & Davis.
22 x 8 Lodge & Shipley, turret lathe.
20 in. Potter & Johnston.
16 x 5 Pratt & Whitney.
22 x 7 Pratt & Whitney.
No. 2½ Pratt & Whitney, 1¼ in.
No. 3 Pratt & Whitney, 2 in.
No. 3 Pratt & Whitney, 2⅛ in.
No. 3 Pratt & Whitney, 2⅜ in.
No. 1 Prentiss.
15½ Dreses & Mueller universal.

Bufters.

Perry Ransom special.
No. 1½ Diamond.
No. 1 North Hampton.
No. 2 North Hampton.
No. 3 Vulcan.
No. 4 Vulcan.

Bolt Cutters.

1 in. Acme, double head.
Two old style bolt cutters.
1½ in. National, complete.
2 in. National, complete.
2½ in. National, complete.

Grinders.

Brown & Sharpe cutter and tool grinder.
Cincinnati cutter and tool grinder.
No. 2 Clark electric center grinder.
Diamond cone grinder.
Diamond cup grinder.
No. 6½ Diamond water tool grinder.
Twist drill grinder.
Gisholt tool grinder (fine condition).
Universal bench grinder.
Springfield double wheel water tool grinder.
Hisey-Wolf electric center grinder.
No. 4 Lancaster.
No. 5 Lancaster.
No. 6 Lancaster.
Wallace chaser grinder.
No. 2 Partridge grinder.
No. 4 Partridge grinder.
No. 1 Vulcan grinder.
No. 2 Vulcan grinder.
No. 3 Vulcan grinder.
No. 4 Vulcan grinder.
No. 5 Vulcan grinder.
No. 6 Vulcan grinder.
No. 7 Vulcan grinder.
18 in. Vulcan universal disc grinder.
18 in. Electric driven grinder.
20 in. Vulcan water tool.
Electrically driven 20 in. Vulcan water tool.
Springfield dry grinder.
Yankee twist drill grinders,
Styles "D," "L" and "P."

Presses.

C2 Ferracute.
C3 Ferracute.
C4 Ferracute.
C101 Ferracute.
D72 Ferracute.
P1 Ferracute.
P3 Ferracute.
P4 Ferracute.
No. 3 Toledo.
No. 31 Toledo.
No. 32 Toledo.
No. 0 Vieillard & Osswald.
No. 2 Vieillard & Osswald.
No. 3 Vieillard & Osswald.
No. 5 Vieillard & Osswald.
No. 62 Toledo.
Crosby foot press.
Fox ball cup press.
No. 123 Ferracute drawing press.
No. 6 Waterbury Farrel.

Miscellaneous.

¼ in. positive pressure blower.
Vulcan brazer.
Bolt pointer.
Cutting-off machine.
2½ in. Betts cutting-off machine.
Drop hammer.
Circular saw.
Springfield oil separator.
Pulley molding machine.
Waterbury Farrel double scarfing machine.
20 ft. Bending rolls, fine condition.
Fox tube cutter.
Spoke header.
Tapping machine.
P. & W. 2-spindle profiler.

A large assortment of Vises, Grinder Stands, Buffing Stands, Chucks, Etc.
A large stock of standard size new machinery. Can make prompt shipment.
One-Hundred page catalog. Yours, if you want it. Send address.

Marshall & Huschart Machinery Co., 62-64 South Canal St., Chicago.
Branch Office: 22-24-26 Lake Street, Cleveland, Ohio.

McCabe's LIST

NEW LOT
SECOND-HAND TOOLS.
Low Prices.—Immediate Delivery.
REVISED WEEKLY

Planers.

60 in. x 60 in. x 24 ft., Two Heads. Fitchburg.
48 " x 48 " x 16 " One Head. Fitchburg.
47 " x 36 " x 12 " " New Haven.
36 " x 30 " x 14 " " Powell.
32 " x 32 " x 8 " Two Heads. Pond.
26 " x 26 " x 7 " One Head. New Haven.
24 " x 24 " x 12 " " Pease.
24 " x 24 " x 8 " " Ames.
24 " x 24 " x 6 " " Fitchburg.

Lathes.

88 in. swing x 22 ft. Bed, Triple Geared, Screw Cutting, Compound Rest and Cross Feed, complete.
50 in. swing Pulley Lathe. Niles Tool Works.
36 " x 15 ft. Bed, complete. New Haven.
30 " x 12 " " " David W. Pond.
28 " x 20 " " " Putnam Mach. Co.
24 " x 10 " " " New Haven.
21 " x 20 " " " Nicholson & Waterman.
20 " x 10 " " " Star Tool Co.
18 " x 14 " " " Fitchburg.
18 " x 8 " " " Dustin.
16 " x 10 " " " Perkins.
16 " x 6 " " " Bement.
14 " x 6 " " " Fitchburg.

Drills.

Upright 28 in. swing, complete. Barnes.
" 45 " " " New Haven.
Radial 5 ft. arm, complete. Hilles & Jones.
Multiple 4 spindle, " Niles.

Miscellaneous.

Niles Boring and Turning Mill 52 inch, double head.
Horizontal Boring Machine, 3 in. bar, 48 in. feed. Fitchburg.
Turret Chucking Lathe, 36 in. swing. Lodge & Davis.
Universal Milling Machine No. 2. Brainerd.
Automatic Cutter Grinder, complete.
Shapers, 10, 16, 24, Crank and Friction.
Slotters, 8 and 10 in. stroke. Bement, and Niles.
Keyseater 16 in. stroke. Colburn.
Screw Machine 1 13-16 wire feed friction head. Bardons & Oliver.
" " " 1 1/16 " " Jones & Lamson.
" " " 3/4 " " Brown & Sharpe.
Power Presses. Bliss, Stiles and Farrell.
Pipe Machines, 4 and 6 inch capacity.
Car Wheel Borer, 48 inch.
Boiler Bending Rolls, 10 ft., hinged housing.

LARGE STOCK NEW STANDARD TOOLS.

J. J. McCABE,
14 Dey Street, NEW YORK.

Largest Stock of . . .

Machine Tools, Boilers, Engines and Dynamos.

Send for Special Detail Catalog of Two Thousand Pieces.

FRANK TOOMEY,
127-131 N. Third Street, PHILADELPHIA.
Long Distance Telephone 261-262.

NEW AND SECOND-HAND.

1 each new 40 in., 50 in., 60 in. and 72 in. Wais & King boring mill, swing 4 in. over size.
1 38 in. x 30 ft. compound rest lathe, New Haven, good as new.
1 57 in. x 16 ft. plain rest engine lathe.
1 60 in. x 23 ft. comp. rest eng. lathe, Gage.
1 36 in. x 36 in. x 10 ft. planer, spr. dr., Sellers.
1 36 in. x 36 in. x 13 ft. planer, Thayer & Houghton.
1 36 in. x 36 in. x 6 ft. planer, Whitcomb.
1 30 in. x 30 in. x 5 ft. planer, Whitcomb.
3 Grant & Bogart double column mill'g machs.
1 10 ft. radial drill press, McNaul.
1 112 in. radial drill press, Box &Son.
2 new 62 in. Mueller radial drills.
1 24 in. friction geared shaper, Hendy.
1 38 in. drill press, B. G., P. F. and auto. stop, New Haven.
1 2-spindle profiler, good as new, Ames.
1 48 in. spur gear cutter, Brainard.
1 48 in. universal gear cutter, Pond.
1 American Oil Gas Machine No. 3, capacity 5,000 cubic ft. per hour, good as new
1 9 ft. single head bor. and turn. mill, Niles.
150 lathes, 10 in. to 60 in. swing.

J. H. DAWSON MACHINERY CO.,
39-41 South Canal St., CHICAGO, ILL.

SECOND-HAND TOOLS.

LATHES.

12 x 5 Robbins.
13 x 5 Pratt & W.
14 x 6 Blaisdell.
15 x 6 Pratt & W.
16 x 5 Pratt & W.
16 x 6 Flathers.
16 x 6 Ames Mfg. Co.
16 x 6 Fifield.
16 x 8 Pratt & W.
18 x 6 Lodge & Davis.
18 x 8 Pratt & W.
21 x 8 Pratt & W.
27 x 20 Pratt & W.
42 x 13 Pulley.
42 x 20, with tpr., Nl's.
20 ft. swing Pit Lathe.

PLANERS.

16 x 16 x 42 Walters Bros.
20 x 20 x 6 P. & W.
36 x 33 x 11 Harris.
36 x 36 x 17 N. Y. Engine Co.
10 x 7 x 46 Industrial Works, 2 heads.

BORING MACHINES.

No. 1 Locomotive Cylinder Boring Mach., Newton.
3 in. Bar Horizontal, Frederick Miles.
28 x 12 Hori., Sellers.
60 x 12 Hori., Pond.
14 x 16 Star Feed Boring Bar.

MILLING MACHINES.

No. 2 Hand, Garvin.
No. 3 Garvin.
No. 2 Plain, Garvin.
Hand, Ames Mfg. Co.
48 x 14 Plain, B. & S.
36 in. x 36 in. x 13 ft. Ingersoll, planer type.
Pratt & W., Lincoln.
Double Col. Grant, Pratt & Whitney.
6 ft. bed Duplex, Newton.
22 in. x 22 in. x 6 ft. 6 in. Newton.

MISCELLANEOUS.

No. 2 3-spindle Garvin Drill.
No. 3 4-spindle Garvin Drill.
48 in. Upright Drill, Putnam.
16-spindle Car Wheel Drill, Niles T. W.
6-spindle Hendey Drill Press.
14 in. P. & W. Shaper.
1 1/4 in. Single Morgan Bolt Cutter.
1 in. Double Morgan Bolt Cutter.
24 in. Gould & E. Gear Cutter.
No. 2 Perkins Screw Press.
One 2 H.-P. Consolidated Speed Controller.
Hydraulic Riveter & Crane, Capacity closing 1 in. rivets, pressure 35 gross tons, gap 8 ft. 2 in., with Tower Crane, 15 tons capacity, 20 ft. span.
3 ton Hand Crane, 14 ft. 11 in. span.
3 ton Hand Crane, 11 ft. 11 in. span.
5 ton Hand Crane, 14 ft. span.
5 ton Hand Crane, 29 ft. span.
5 ton Hand Crane, 32 ft. span.
One Newton 8 ft. Floor Bor. Machine.
Sturtevant Blower & Heater.
No. 8 Bement Single Punch, 36 in. gap, cap. 1 1/4 in. hole in 1 in.
1,500 lb. Bement Stm. Hammer.

SEND FOR DETAILED LIST AND PRICES.

THE NILES TOOL WORKS CO.,
136 Liberty Street, New York.

MACHINERY BARGAINS.

9 Screw Machines, fine shape, price low.
2 Turret Lathes.
5 Screw Cutting Engine Lathes.
1 Dayton Swaging Machine, like new, half price.
Lot Iron Bench Vises, half price.
2 tons good second-hand Leather Belting.
15 Buffing Machines with countershafts.
1 Hendy Shaper, friction geared.
1 Brown & Sharpe Miller.

Send for complete list and prices.

TWO GASOLINE AUTOMOBILES, like new, only used as samples.

A. W. GUMP & CO.,
DAYTON, OHIO.

C. C. Wormer Machinery Co.

CONTRACTING ENGINEERS

Complete Power Plants Designed and Erected.

Estimates cheerfully furnished. Let us figure with you.

Bargains in second-hand Engines, Boilers, Pumps, Air Compressors and Heavy Machinery.

LARGE STOCK OF NEW MACHINERY.

MAIN OFFICES:
97, 99, 101 Woodbridge St., DETROIT, MICH.
WAREHOUSES: 55, 57 and 59 Shelby St.

New and Second-Hand MACHINERY

Lathes.

20 ft. pit lathe, with 10 ft. face plate.
50 x 15 New Haven, triple grd. (practically new).
36-48 x 22 Bement, grd. in face plate.
36 x 24 N. Y. Steam Eng. Co. ditto, grd. in face plate.
37 x 23 Betts, grd. in face plate, with chuck.
30 x 13 Nicholson & Waterman, C. R., P. C. F.
30 x 15 Fish, C. R. & P. C. F.
27 x 14 Blair, C. R. & P. C. F., heavy.
26-50 x 10 Bullard gap turret lathe, double friction back grd. head and fitted with taper, 3 1/2 in. hollow spindle.
20-25 x 10 Flather, C. R. & P. C. F.
18 x 8 Blaisdell, R. & F.
Two 17 x 8 Flather, R. & F. & P. C. F., A1.
Two 16 x 8 Blaisdell, comp. rest & taper, A1.
16 x 6 Lodge & Davis, C. R., P. C. F., taper at.
Bement single end axle lathes.
Two 16 in. Dreses-Mueller back grd. monitors, auto. chuck.

Planers.

48 x 42 x 12 L. W. Pond, 2 heads, new.
36 x 36 x 12 New Haven, 1 head.
36 x 36 x 12 N. Y. Steam Eng. Co., 1 head.
30 x 30 x 8 Harrington, 1 head.
26 x 26 x 6 Putnam, 1 head.
16 x 16 x 4 Lathe & Morse.
Three 16 in. crank planers.

Milling Machines.

Heavy pat. Pedrick & Ayer heavy univ., all feeds.
No. 4 Cin. univ., all attachs.
No. 3 Garvin univ., all attachs.
No. 3 Cin. univ., good as new.
P. & W. rack cutter (semi-auto.).

Drills.

3 & 6 ft. Bickford radials, new.
4 ft. Betts plain radial, good order.
2 5 ft. Niles semi-universal.
5 ft. arm Bdush radial, wood.
No. 0 Bickford radial with 3 ft. arm, good as new.

Shapers.

28 in. Smith & Mills, triple grd.
24 in. Walcott, triple grd.
4 traveling head shapers.

Grinders.

No. 2 B. & S. univ.
No. 1 ditto.
Nos. 2 & 3 Landis univ.
Cin. plain cutter and reamer grinder.
Gisholt tool grinder.
No. 3 B. & S. cutter.
No. 14 Landis plain.

Screw Machines.

2 in. Cleveland auto. good.
5/8 in. B. & S. auto.
No. 1 P. & W., wire feed.
20 in. x 7 ft. F. & S. univ. turret lathe.
Davis & Egan hub machine.

Miscellaneous.

3 in. bar Bement & Miles horiz. boring mach.
84 & 72 in. Bickford vert. boring mills.
42 in. R. & H. ditto.
18 ft. Swampscott plate planer.
250 lb. Dinelt & Eisenhaut power hammer.
75 lb. ditto.
600 lb. Chambersburg steam hammer, single frame.
400 to 1,700 lb. Merrill frict. drop hammers.
600 lb. P. & W. drop hammer.
36 in. Whiton auto. gear cutter, A1.
S. P. Ruggles rotary spitting shear for safe manufacturing.
1-spindle Garvin profiler.
2-spindle P. & W. profiler.
12 ft. Knowlton boring mill, A1.
Also large stock of other tools. Send for prices and descriptions.

Prentiss Tool & Supply Co.,
115 Liberty St., NEW YORK, N. Y.

Buffalo, 507 D. S. Morgan Bldg.
Pittsburg, 120 1st Ave.
Boston, 200 Franklin St.

FOR SALE.

Machine Shop and Foundry with equipment capable of employing sixty hands, in a flourishing city in Maine. Have a fine trade in gears and general mill work. Reason for sale will be furnished interested parties.

Write to S., Box 862, care of American Machinist.

PLANERS! PLANERS!

60 in. x 60 in. x 25 ft. Betts, 3 heads.
27 in. x 27 in. x 5 ft. New Haven.
25 in. x 25 in. x 6 ft. Whitcomb.
19 in. x 24 in. x 20 ft. Stearns.

RADIAL DRILLS.

90 in. Mackintosh Hemphill.
70 in. Betts.

Turret and Upright Drill Presses.

CARLIN MACHINERY & SUPPLY CO.,
Lacock & Sandusky Sts., Allegheny, Pa.

LATHES.

1—11 in. x 5 ft. Prentice Engine Lathe.
1—13 in. x 6 ft. Pratt & Whitney Eng. Lathe, taper attachment.
1—14 in. x 4½ ft. Jones & Lamson Eng. Lathe.
1—14 in. x 8 ft. Blaisdell Lathe.
1—16 in. x 5 ft. Pratt & Whitney Eng. Lathe, taper attachment.
1—17 in. x 6½ ft. Amer. T. & M. Co. Eng. Lathe, taper attchmt.
1—18 in. x 6 ft. Blaisdell Engine Lathe.
1—18 in. x 11 ft. New Haven Lathe.
1—20 in. x 5 ft. Bullard Turning Lathe, power cross feed.
1—20 in. x 21 ft. Johnson Engine Lathe, taper attachment.
1—26 in. x 10 ft. New Haven Engine Lathe.
1—48 in. x 24 ft. Triple Geared Engine Lathe.

PLANERS.

1—15 in. x 15 in. x 3 ft. Planer.
1—24 in. x 24 in. x 5 ft. Powell Planer.
1—30 in. x 24 in. x 6 ft. Chamberlain Planer.
1—36 in. x 36 in. x 10 ft. Sellers Planer.

BLOWERS.

1—No. 9 Sturtevant Pressure Blower.
1—No. 6 Sturtevant Monogram Blower.
1—40 in. Buffalo Exhauster. 1—16 in. Bost Blower.

MISCELLANEOUS.

1—Motor Driven Portable Air Compressor.
1—25 in. Blaisdell Upright Drill.
1—25 in. Allen Pneumatic Riveter.
1—4 in. x 10 in. x 6 in. Steel Boring Bar, 3 heads.

BAIRD MACHINERY CO.,
123-125 WATER STREET. PITTSBURG, PA.

BARGAIN TOOLS

Our Bargains are Bargains.

1 Yale & Towne Electric Crane, 23 ft. 4 in. between tracks, capacity 12,000 lbs., in good order, with 104 ft. of track.

1 R. Dudgeon 650 lb. Steam Hammer.

1 New Haven Engine Lathe, 38 in. x 19½ ft., taking 13 ft. between centers, complete with taper turning attachment.

1 Warren Radial Drill, 4½ ft. arm.

1 Warren Radial Drill, 5 ft. arm.

1 Baush Radial Drill, 5 ft. arm.

1 No. 6 Bardons & Oliver scr. mach., complete.

1 Betts Planer, 60 in. x 50 in. x 18 ft., with 2 heads, in first-class order.

1 Wheeler Planer, heavy pattern, 30 in. x 30 in. x 8 ft.

Send for our special bargain list.

Hill, Clarke & Co.,
156 Oliver Street, - Boston, Mass.

Wormer's List

(List corrected Weekly.)

LATHES.

11 in. x 4 ft. 3 in. Barnes, ft. pr.
10 " x 4 " Sebastian
11 " x 5 " Cady
12 " x 4 " Dexter
12 " x 5 " Reed
13 " x 5 " Sebastian
13 " x 6 " Blaisdell
13 " x 6 " Ames
14 " x 6 " G. & B.
15 " x 5 "
16 " x 6 " Blaisdell
18 " x 8 " New Haven
19 " x 7 " 5 in. W. & L.
20 " x 6½ ft. New Haven
22 " x 14 " Williams
24 " x 14 " Porter
29 " x 12 " Putnam
New lathes 10 to 36 in. swing, various bed lengths, all makes

PLANERS.

16 in. x 12 in. x 15½ in. Bradford
17 " x 17 " x 4 ft. Whitcomb
32 " x 24 " x 8 " Parsley

SHAPERS.

6 x 9 Boynton & Plummer
8 x 12 " "
10 in. crank, Dustin
20 in. x 6 ft., traversing head, N. Y. S. Engr. Co.

DRILLS.

13 inch friction disc, Barnes
13 " Knecht
15 " sid hd., W. & R.
4 ft. plain radial, D. S. & B.
2 spindle adjustable, F. & B.
15 inch Burnham
3 spindle B. & D.
6 spindle turret, Quint
26 inch Prentice, sliding head
35 inch Blaisdell, S. H., B. G.

MILLERS.

No. 11 plain Garvin
No. 1 plain, L. & D.
Bench and hand millers, Garvin and Ames Lincoln millers

HAMMERS.

35 lb. Justice
50 " board lift, P. & W.
50 " Justice
100 " power, Cox
200 " cushion, Hackney
600 " auto. trip, Bliss
100 " board lift, Merrell

RAILWAY TOOLS.

48 inch Car Wheel Borer
14 in. x 11 ft. single head Axle Lathe, Industrial Iron Wks.
16 in. x 11 ft. self centering, sin.hd. Axle Lathe. F.B.Miles

MISCELLANEOUS.

Horizontal Boring Machines
24 inch semi-auto. American Turret Lathe
No. 1 Toledo Press
No. 4 " "
Auto. Wire Straightener
Keyseaters, Baker & Davis
Tapping Machines, Garvin
Boring Bars
B. & S. Polishing and Finishing Machines
36 inch G. & E. Gear Cutter
31 " Vertical Boring Mach.
Cent. Oil Extracter
No. 2 Bliss ovrhang'g Scw. Press
Gear Cutting Attach. for lathes
175 light Dynamo
Screw Machines, Turret Lathes, Blowers, Pipe Machines, and a large stock of general machinery

Good Goods, Low Prices, Quick Service, for Factory, Mill or Shop.

Large Stock of New Machinery.

C. C. WORMER MACHINERY CO.
Foot of Wayne St., DETROIT, MICH.

Horizontal Boring Machine.

We offer our 2½ inch bar, 5 foot table machine, which we have been using for a short time in our works. Perfect order, practically new.

The Binsse Machine Co.,
NEWARK, N. J.

Just Received at Our Warehouses.

3 Jones & Lamson Flat Turret Lathes.
2 No. 7 Baker Blowers, also 1 No. 7½.
1 150 lb. Hackney Hammer, also 1 50 lb.
1 18 in. Morton Keyseater.
1 21 in. x 12 ft. Silk Engine Lathe, new.
3 2 in. Cleveland Automatic Screw Machines.
1 No. 12 Brown & Sharpe Milling Machine.

GEO. H. BOWLER & CO.,
Williamson Bldg., Cleveland, Ohio.

BARGAINS.

14 in. x 6 ft. Eng. Lathe, Windsor.
16 in. x 6 ft. Fox Monitor, American.
18 x in. x 5 ft. Monitor Lathe, Windsor.
18 in. x 8 ft. Eng. Lathe, Porter.
19 in. x 10 ft. Eng. Lathe, Silk.
22 in. x 10 ft. Eng. Lathe, Davis.
30 in. x 12 ft. Eng. Lathe, New Haven.
20 in. B. G. & S. F. Drill, Davis.
62 in. Radial Drill, Mueller.
16 in. x 16 in. x 4 ft. Planer, Hendey.
20 in. x 20 in. x 5 ft. Planer, Ames.
24 in. x 24 in. x 5 ft. Planer, New Haven.
No. 18 Bliss pattern Press.
No. 20 Bliss Power Press.
Nos. 3 & 36 Presses, Niagara.
No. 1 Hand Miller, Garvin.
No. 2 W. F. Screw Machine, Garvin.
No. 25 B. G. Miller, B-Brainard.
900 lb. Drop Hammer, Merrill.
Pair 40 in. Geared Hand Rolls.

Sensitive Drills, Presses, Millers, etc.

Can give bargains in new and second-hand machines at all times for immediate shipment.

GEORGE E. AFFLECK,
No. 109 Liberty St., - N. Y. CITY.

Desirable Second-Hand Machinery.

LATHES.

14 in. x 4½ ft. Putnam.
14 in. x 5 ft. Lathe & Morse.
14 in. x 6 ft. Bogart, rise and fall rest.
14 in. x 6 ft. Le Blond Stud Lathe.
15 in. x 6 ft. Wood & Light, rise and fall.
16 in. x 6 ft. Putnam, and chuck.
16 in. x 7 ft. Lathe & Morse.
20 in. x 7 ft. Conway, plain rest, power cr. fd.
20 in. x 8 ft. Pratt & Whitney, plain rest.
22 in. x 18 ft. Pond. 15 in. x 5 ft. Reed.
24 in. x 19 ft. Pond. 60 in. Pit Lathe.
28 in. x 20 ft. Harris Gap Lathe.
32 in. Putnam Pulley Lathe.
20 in. Potter & Johnson Turret Lathe.
62 in. x 14½ ft. New Haven, trp. gd., fine con.

MILLING MACHINES.

No. 1 Brown & Sharpe universal.
No. 12 Brown & Sharpe plain.
No. 2 Cincinnati plain.
Garvin Hand Miller.
No. 1 Garvin universal.
No. 4 Garvin. No. 3 Kempsmith.
No. 2 Garvin. No. 10 Kempsmith.
No. 2 Kempsmith. Lipe universal.
No. 2 Pratt & Whitney hand.
No. 2 Pratt & Whitney, Lincoln pattern.
Pedrick & Ayer heavy plain miller.
Pratt & Whitney duplex No. 3½, 8 ft. platen.
Pratt & Whitney, Lincoln pattern.

PLANERS.

16 in. Crank Planer.
24 in. x 24 in. x 6 ft. Pease.
26 in. x 26 in. x 6 ft. Wheeler.
36 in. x 36 in. x 10 ft. New Haven.
72 in. x 60 in. x 14 ft. Betts.

PRESSES.

Crosby Foot Press.
No. 123 Ferracute Drawing.
No. 62 Toledo.
No. 6 Waterbury-Farrel.
D-2 Ferracute Drawing.

SCREW MACHINES.

No. 1 Brown & Sharpe automatic.
14 in. Brown & Sharpe auto. Turret Lathe.
2 in. Cleveland automatic.
18 in. Davis & Egan Screw Machine.
No. 1½ Dreses-Mueller Screw Machine.
24 in. x 7 ft. Garvin Turret Lathe.
No. 2 Hartford automatic, double spindle.
1⅝ in. Hartford automatic.
2¾ in. Hartford automatic.
19 in. x 6 ft. Lodge & Davis.
20 in. Potter & Johnston Turret Lathe.
16 in. x 5 ft. Pratt & Whitney.
22 in. x 7 ft. Pratt & Whitney.
22 in. x 8 ft. Lodge & Shipley Screw Machine.
Garvin Hub Forming Machine.
No. 2½ Pratt & Whitney, 1¾ in.
No. 3 Pratt & Whitney, 2 in.
No. 3 Pratt & Whitney, 2⅛ in.
No. 3 Pratt & Whitney, 2⅝ in.
No. 1 Prentiss.

DRILLS.

22 in. Hamilton, B. G. & P. F.
24 in. Barnes.
24 in. Schumacher.
30 in. Lodge & Davis radial.
80 in. Dietz radial.
4-spindle Pratt & Whitney.

BORING MILLS.

60 in. Sellers. 80 in. Sellers.

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Diamond Cup Grinder.
No. 6½ Diamond Water.
Garvin Grinder.
Gisholt Tool Grinder.
Springfield Double Wet Grinder.
Universal Bench Grinder.
Grindstone Frame and Stone.
Brown & Sharpe Univ. Tool Grinder.
Diamond Cone Grinder.
Cincinnati Cutter & Tool Grinder, plain.

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¼ in. Positive Pressure Blower.
1½ in. Acme Bolt Cutter.
1 in. Acme Double Bolt Cutter.
Bolt Pointer. No. 5. Ajax Bulldozer.
Vulcan Brazer. Cutting-off Machine.
2½ in. Betts Cutting-off Machine.
Drop Hammer.
Springfield Oil Separator.
Pulley Molding Machine.
Double Scarfing Machine, Waterbury-Farrel.
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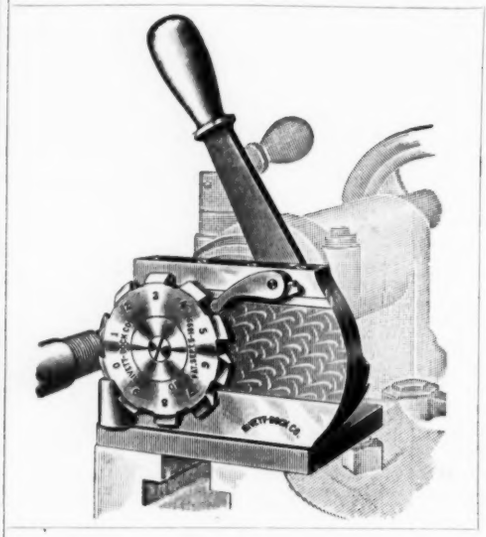

This is the new modern Threading Tool that is taking the place of the single point tool in so many machine shops, because of the ease and rapidity with which it cuts threads. It is a great improvement over every other kind of threading tool. With a single sharpening it will make a hundred cuts to one of any tool of the single point type and every thread will be accurate to the minutest degree. With the single point tool, results depend entirely upon the skill of the operator. With the Rivett-Dock tool no skill is required; any person capable of reversing a lathe can at once cut accurate and finished threads without fear of mistake or failure. The best evidence we can present is what the tool actually accomplishes in representative shops. For instance:

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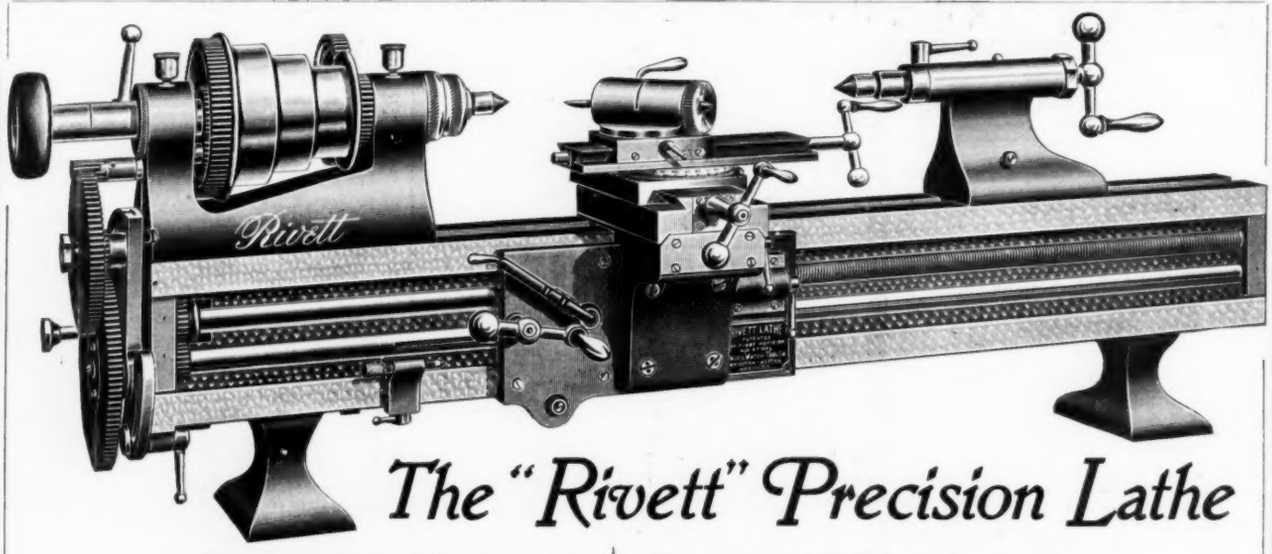
Yours Truly,

The Ballard Machine Tool Co.,
H. F. Brandes, Supt.

We have sold so many of these tools and are so sure that the tool will give satisfaction, that we will send one on trial to any responsible firm. Write for Catalog giving all the details.

The Rivett-Dock Co., Brighton, Boston, Mass., U.S.A.



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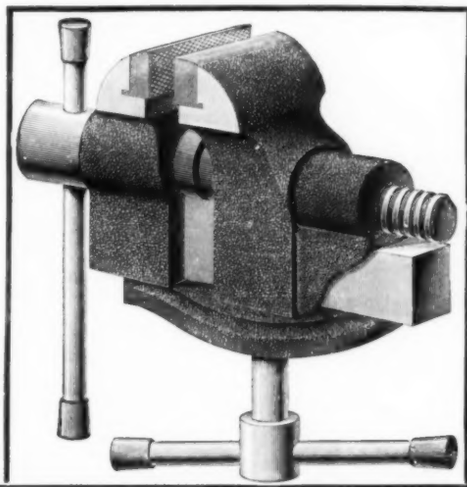

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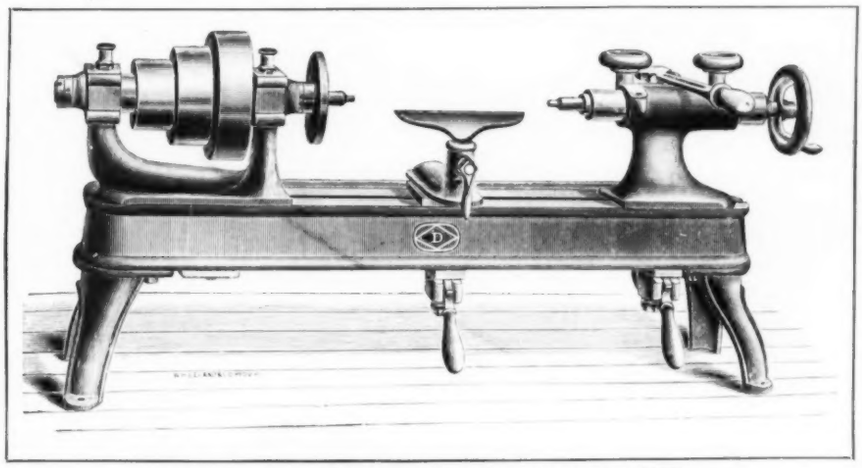

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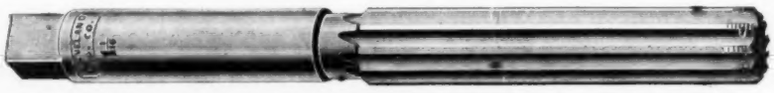

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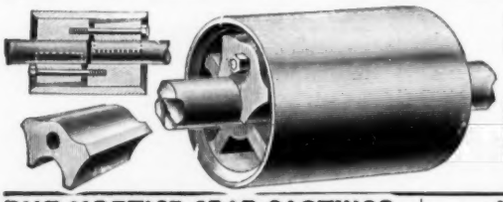

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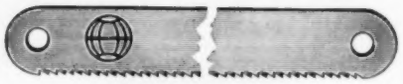

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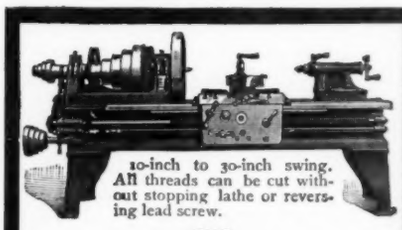

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A New Principle in Hydraulic Presses.

The accompanying illustrations show in several applications a new principle in hydraulic presses which has recently been brought to this country by its inventor, Otto Philipp, of 17 Irving Place, New York. It accomplishes two main objects. First, it saves the loss of power due to the preliminary or take-up movement of the plunger by high-pressure water and, as the outgrowth of this, it saves the cost of the surplus capacity of machinery necessary to produce that power. Secondly, it does away with the usual hydraulic plant of pumps, accumulator and piping. Each press is entirely self-contained and is driven by a belt or electric motor, the pressure for operating each machine being generated within itself. Moreover, the pressure produced is only that actually used, there being no loss due to the throttling of high-pressure water for machines that are operated under less than their full load.

Fig. 1 shows a small hand press which may also be considered as a schematic illustration of the general invention. In this illustration *a* is the cylinder and *b* is the main plunger or ram. A hollow screwed spindle *c* acts at its lower end as a hydraulic plunger and produces the high pressure required for the work. By the collar *d*, at its lower end, and the corresponding cross plate *e* on the main ram, the spindle serves also to return the main plunger after the working stroke by mechanical engagement.

The hand wheel *f*, by which the screwed plunger is operated, has a water tank formed as part of it and, at the lower end of this plunger is a valve *g* which is not shown in operative form in this illustration, but it is so shown in Fig. 2. Assuming the valve shown in Fig. 1 to be operative, the action of the machine is as follows: A piece of work requiring to be pressed having been placed upon the platen the hand wheel is turned and the screwed spindle descends. The pressure of water due to the elevation of the tank causes the main plunger to descend as rapidly as the screwed spindle will permit. When

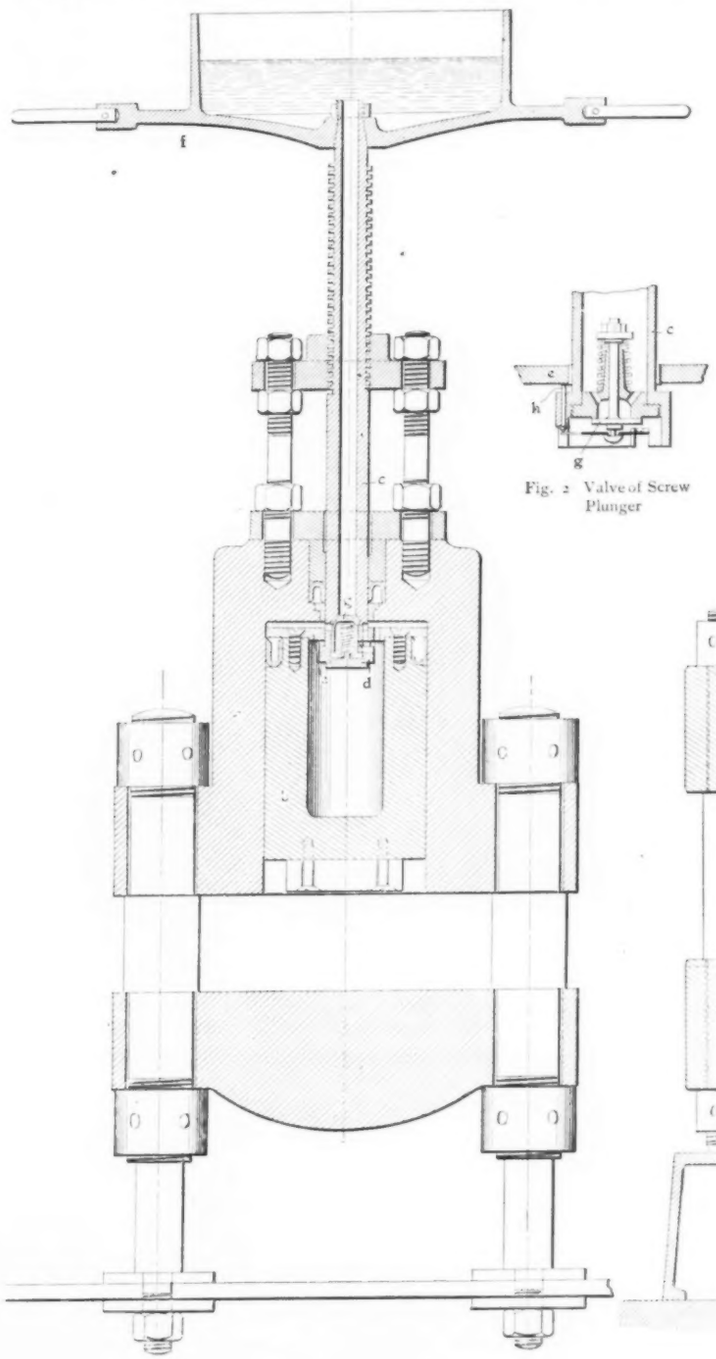


FIG. 1. 40-TON HAND PRESS.

Fig. 2 Valve of Screw Plunger

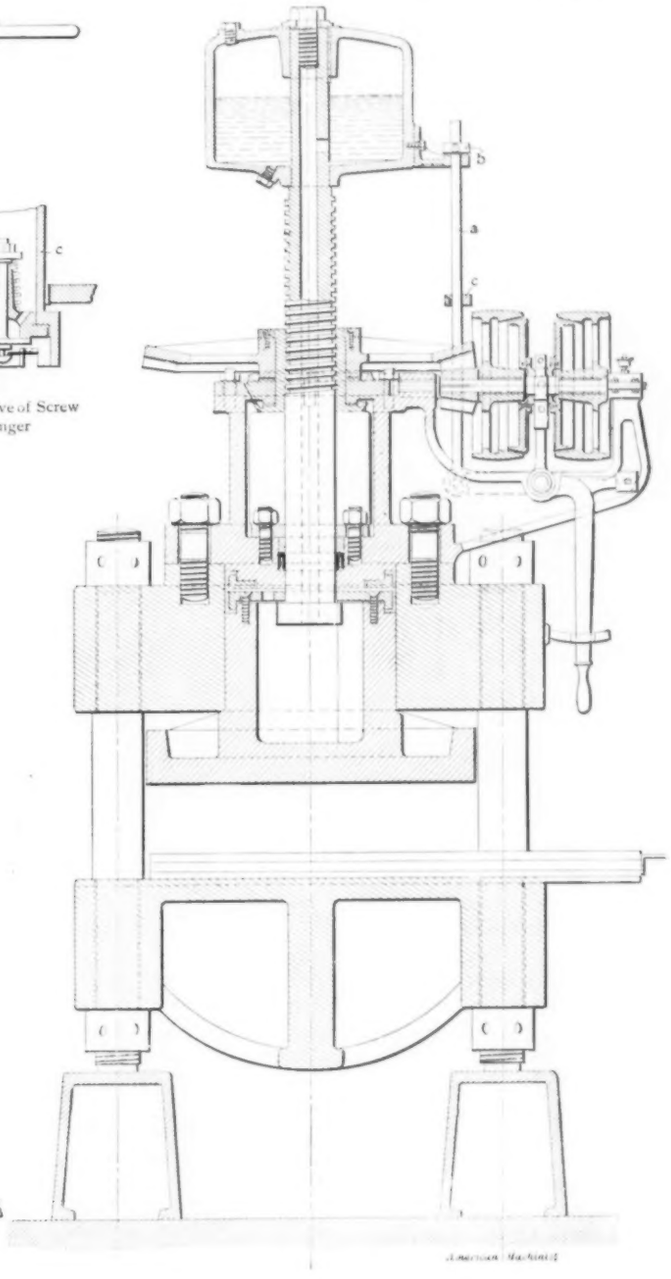


FIG. 3. 200-TON POWER-DRIVEN BOOKBINDER'S PRESS.

contact with the work takes place, the pressure due to the head of water is no longer sufficient, but further movement of the screw causes the screwed spindle to act the part of a pump plunger. The valve *g* closes, the screwed plunger descends within the hollow main plunger and the pressure required f r doing the work is produced. Reversing the motion of the hand wheel withdraws the screwed plunger from the hollow of the ram, which latter ascends at a speed determined by the ratio of areas, until the collar *d* engages plate *e*. Slightly before this engagement the pin *h* of Fig. 2 engages this plate and opens valve *g* when the further upward movement of the screwed plunger raises the ram by mechanical engagement and at the same time returns the water to the tank. The machine shown in Fig. 1 was made for making test briquettes of cement and for other similar work. Its capacity is 40 tons.

Fig. 3 shows a 200-ton power press arranged for bookbinders. The principle is precisely the same as in the previous press, the only structural variation being the addition of gearing, friction clutches and belt pulleys, to operate the press by power. Open and crossed belts drive the pulleys, a hand lever controlling the clutches and the direction of motion. A nut *a* with stop collars *b* and *c* limits the movement in both directions, and a safety valve prevents overloading.

Fig. 4 shows a power-driven stationary riveting machine. In this case there is no water tank, the machine being connected to the public water supply main at *a*, from which a greater initial pressure is obtained than from a tank located on the machine. It will be observed that there is—or need be—no consumption of water, as the return movement of the ram returns the water to the mains. It will be observed also that the machine may be used for large or small rivets with a consumption of power proportionate to the work done.

Fig. 5 shows a portable staybolt cutter which contains still another variation. In this case the machine contains a closed water chamber *a* which contains a collapsible rubber bag *b*. This bag is filled with a sealed charge of compressed air by the valve *c*. This portable charge of pressure water obviously acts precisely like a connection to a water main. The screw plunger is modified to suit the position of the water chamber and also to make the machine more compact, but the essential principle is unchanged. Like the first machine shown, this is worked by hand power.

Fig. 6 shows a portable riveting machine which, like the staybolt cutter, is fitted with an air bag, but the screw plunger is in this case driven by an electric motor. The reversal of the motion of the screw is obtained by two sets of gears which are fitted with magnetic friction clutches. This machine is intended for driving rivets up to one inch. It is capable of producing pressures up to 50 tons. Its gross weight is 700 pounds and the motor is of ½ horse-power.

Still another modification is shown in the forging press, Fig. 7, which is operated entirely by water pressure, though at a comparatively low pressure—100 to 200 pounds per square inch. The water main is connected with the hollow upper cylinder head *a* and also with port *b* of the valve chest. The slide valve is of such proportions that in the mid position shown

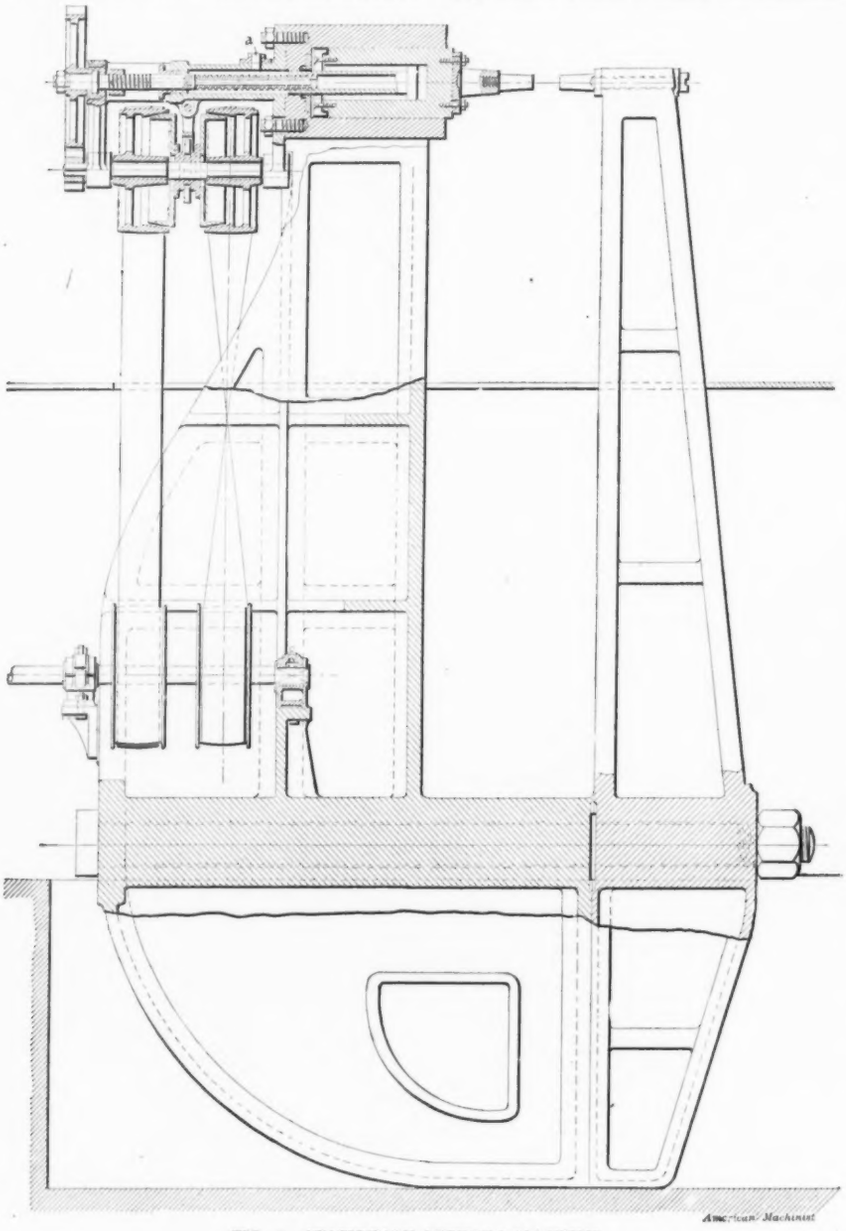


FIG. 4. STATIONARY RIVETING MACHINE.

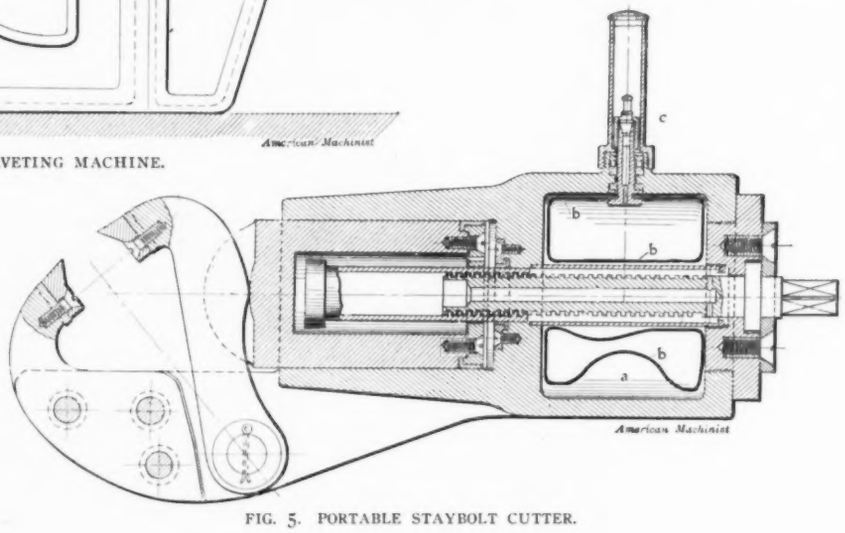


FIG. 5. PORTABLE STAYBOLT CUTTER.

ports *c* and *d* are both open and, through the valve chest, afford free connection between the two ends of the auxiliary cylinder. The exhaust is from the body of the valve chest, but is sealed by having its lower end dip below a water line, in order to prevent air entering the chest as well as to prevent water escaping except as determined by the movements of the press.

In the position shown equilibrium exists between the upper and lower ends of the auxiliary cylinder, but the pressure from the main passes through the tubular plunger *e* into the ram cylinder, and, with the weight of the ram, causes it to descend until the dies come in contact with the work. As the ram descends, the water passes from the lower to the upper end of the auxiliary cylinder and none is consumed there. There is a consumption of water in the ram cylinder, but this is returned to the main on the return stroke. When the dies come in contact with the work, the slide valve is raised, by a suitable hand-lever *f*, admitting the pressure

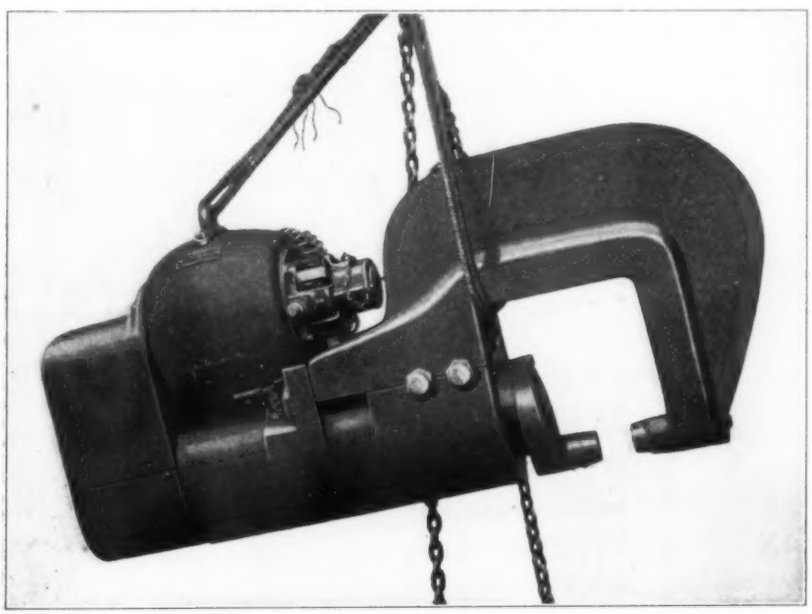


FIG. 6. PORTABLE RIVETING MACHINE.

from the mains to the upper end of the auxiliary cylinder, forcing the tubular plunger down in the manner of the screw in the previous machines. During the actual pressing, water is exhausted from the lower end of the auxiliary cylinder. The work done, the valve is returned to the mid position, re-establishing equilibrium in the two ends of the auxiliary cylinder. The end of the tubular plunger is now well within the main ram, and the pressure from the mains, acting upon the annular area of this plunger, raises it and the auxiliary piston until the contact of the collar at the end of the tubular plunger opens the valve, as described in connection with Fig. 2, when the movement stops. The slide valve is now lowered, admitting pressure from the mains to the lower end of the auxiliary cylinder and causing the ports to rise to the positions shown in the illustration. During the movement the water is exhausted from the upper end of the auxiliary cylinder, but the water which filled the ram cylinder during the first part of the working stroke is, during the return stroke, returned to the mains, thus leading to a small net loss.

Another highly ingenious application of the main principle is to a machine for making pressed brick, a feature of which is that the material is subjected to pressure twice with an interval of time between, whereby the contained air is given an opportunity to escape. As this machine occupies a field of work which is foreign to that covered by this paper, we will omit a detailed description of it.

Progress in the Machine Tool Industry During the Decade 1890-1900.

We extract the following from Census Bulletin No. 247:

The appearance of Ohio as the leading State in the manufacture of metal-working machinery points to one of the interesting phases of the development of this industry during the past ten years. Within this decade there has been a marked tendency toward specialization, particularly among the new establishments that have started business in recent years. Most of the older manufacturers of machine tools, whose business runs back for twenty or thirty years, produce a variety of machines, in some cases embracing nearly everything required for the equipment of a new shop. In late years, however, manufacturers starting in this branch of industry have very generally limited their operations to the production of a single type of machine, or, at the most, to one class embracing tools of similar types. For example, there are large establishments in which nothing is manufactured but engine lathes, other works are devoted exclusively to planers, while in others milling machines are the specialty.

This tendency has prevailed in Cincinnati perhaps more than in any other city, and has been one of the charcteristic features of the rapid expansion of the machine-tool industry in that city during the past ten years. During the census year there were in Cincinnati 30 establishments devoted to the manufacture of metal-working machinery, almost exclusively of the classes generally designated as machine tools, and their aggregate product amounted to $3,375,436.

Philadelphia is one of the largest of machinery centers; 11 establishments reported an aggregate product of metal-working machinery valued at $3,095,574. These products include a wide range of tools with less of the specialization that is characteristic of Cincinnati and other localities where the industry is of more recent growth.

Providence, R. I., ranks third in the manufacture of metal-working machinery, the product of 14 establishments amounting, during the census year, to $2,929,141. Here, again, the industry is diversified rather than specialized. A large amount of automatic and semi-automatic machinery such as screw machines, turret lathes, and gear cutters, and also milling machines of various types, are made in Providence, and these might be said to be the chief characteristic of the industry.

Hartford, Conn., stands next to Providence, and shows about the same features in the machine-tool trade, with a wide range of products, among which automatic and semi-automatic machines might be mentioned as most significant. During the census year 11 establishments in Hartford reported the production of metal-working machinery to the value of $2,796,935.

Worcester, Mass., is another important center for the manufacture of machine tools, with much of the same specialization that is manifest in Cincinnati. Twenty-four establishments reported for the census year products aggregating $2,009,357 in value.

Specialization in the manufacture of machine tools has followed closely the differentiation of processes in other lines of industry, and thus there has been created a multitude of special machines, each designed to perform some single and often very simple operation. The bicycle industry furnishes a striking illustration of the readiness with which the machine-tool builders met the demand for special tools to produce the various parts required in the construction of a bicycle. The advent of the chainless wheel called for a machine which would cut small bevel gears accurately, rapidly and economically, and such machines were quickly forthcoming. This, indeed, is a characteristic tendency of the machine-tool industry—the effort to create new types of tools which will do more and at less cost than can be done

by any of the ordinary appliances at the command of the machinist.

Progress in machine tools and machine-shop practice during the past decade has been marked by the following significant features:

1. The automatic and semi-automatic principles have been extended to new and larger classes of work than before.

2. The forming tool has become a recognized shop appliance.

3. The "oil-tube drill" has been developed from an exceptional to a regularly used tool.

4. Compressed-air portable tools have been developed substantially *de novo*.

5. The application of the power press has been greatly extended.

6. Electrical driving has come into general use.

7. The system of heavy portable machine tools in conjunction with a massive iron floor plate has been originated.

8. The grinding machine has been largely increased in size, power and extent of use.

Closely related to machine-shop practice, though scarcely coming within machine-tool classification, may be mentioned:

9. The development of traveling cranes.

10. The origin of high-speed steels for cutting tools.

These lines of development may be discussed briefly in the above order.

1. The extension of the semi-automatic principle, as illustrated by the hand-operated turret lathe, has been chiefly toward the execution of larger and heavier work, while the use of the entirely automatic turret lathe has been extended not only in the same direction, but it has been adapted to entirely new classes of work. An illustration of the first line of development is found in several types of turret lathes which, although employing certain methods of attacking the work which were not known before their advent, is nevertheless essentially an extension of the turret principle to larger work than had before been done by it.

An illustration of the second line of development is to be found in the "magazine feed" full automatic turret lathe. Prior to the advent of this machine, the full automatic machine had been employed exclusively for making screws, studs, etc., from bar stock which was fed to the machine through the hollow live spindle, the pieces being first turned, threaded, etc., and then cut off, when the bar of stock was fed forward and another piece made, the operation continuing until the bar of stock was used up. The new machine applied the automatic principle to the machining of parts which, when in the rough, were already in separate pieces, *i. e.*, castings or drop forgings. In doing such work the finished piece must be taken bodily from the machine and a new rough piece inserted. This is a fundamentally different operation from merely pushing

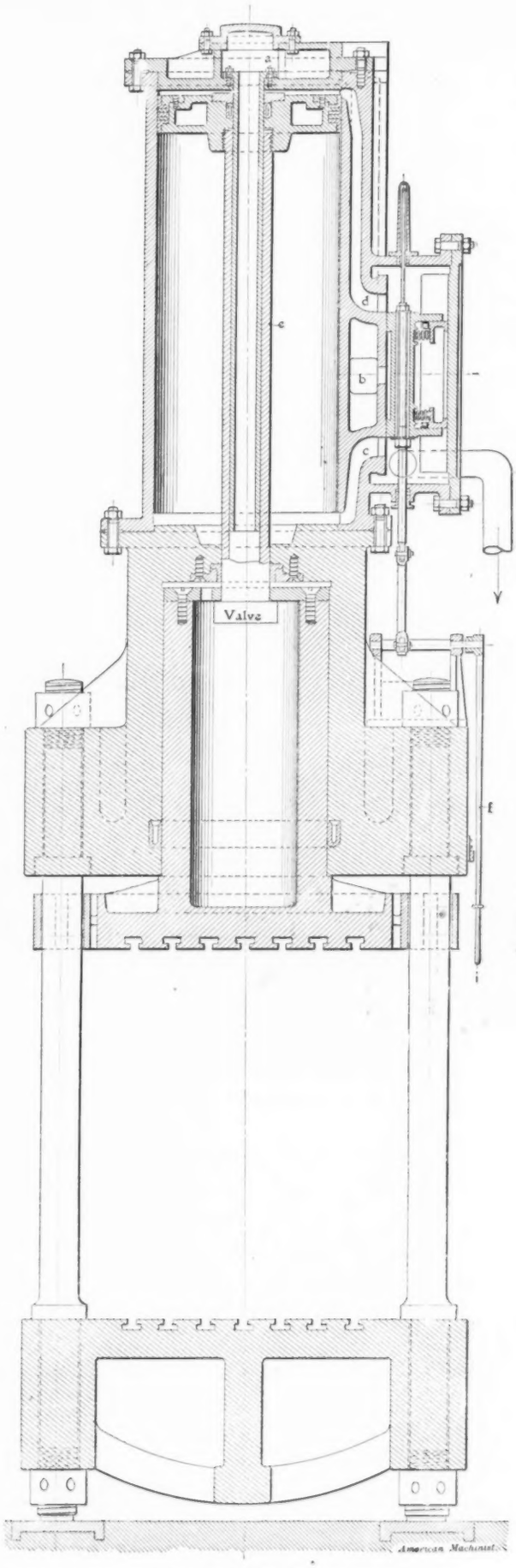


FIG. 7. FORGE PRESS.

a long bar of stock to a new position. It is effected by the "magazine feed," the magazine being filled with rough parts by the workman, these parts then being automatically inserted in the machine and removed therefrom when finished. The line of development exemplified by the machine first mentioned belongs to the entire decade, while that exemplified by the other belongs to its close.

Another line of development in this class of machines which should be mentioned is the use of multiple spindles, whereby the output of certain classes of work is very greatly increased—to the extent of a threefold ratio in some instances. An outgrowth of this development has been the making of small brass screws and similar articles without money consideration, the chips cut off in making the articles being accepted as sufficient payment for doing the work.

2. The use of th forming tool goes back of the decade under consideration, but its use prior to 1890 was chiefly, if not entirely, for the making of articles from very soft composition castings, examples of the work being seen in the caps of salt and pepper boxes. The application of the principle to harder material came about in connection with the bicycle industry, one of its first applications to articles of steel being in the making of bicycle-wheel hubs. If this was not the first application of the method to steel, at least it familarized the mechanical public with it, and from this it has come to have quite an extended application.

3. By the "oil-tube drill" is meant a drill—either flat or twist—having an oil tube or oil channel leading to or near its point, through which a current of oil may be forced to lubricate and cool the cutting edges and to wash away the chips. It is used chiefly for deep drilling in steel and usually in machines of the lathe class, in which the work revolves against a fixed drill, although the arrangement is also used in upright drilling machines, in which the tool revolves. The history of this appliance is almost exactly parallel to that of the forming tool. It was known and used to a limited extent before 1890, having been first used for the drilling of gun barrels; but its more extensive application must, like that of the forming tool, be credited to the bicycle industry, the development of the two tools being, in fact, simultaneous. The forming tool having been successfully applied to the machining of the outside of bicycle-wheel hubs, it was found that a portion of the gain due to its faster action was lost because the simultaneous drilling of the hole required more time than the work upon the outside of the piece. This condition of things led to the adoption of the oil-tube drill for this work, and from this application the use of the appliances has become widely extended. Of the two, the oil-tube drill is no doubt the more important. The increasing use of hollow-spindle lathes and of automatic and hand-operated turret lathes, in which the spindles are necessarily hollow, not to mention milling and other machines having hollow spindles, has given a wide field of usefulness to this tool.

4. The numerous class of small and unpretentious pneumatic tools which came into prominence and extended use during the decade under review may, it is quite possible, be looked upon ultimately as the most important single machine-tool development of the decade. Of these, the first in order of importance as well as of time is the pneumatic hammer. Originally devised as a substitute for the hand hammer and chisel in the machine shop and in stone-cutting, it has extended its field of usefulness to many other fields, and is to-day an indispensable tool in shipbuilding and in the erection of steel-frame buildings. Of the general class of compressed-air tools, the next in importance to the hammer is perhaps the rotary drill, which, in its numerous forms and applications, has introduced mechanical power in place of hand labor for classes of work to which the application of mechanical power seemed almost hopeless. These and numerous other applications of compressed air to machine and similar work stand almost wholly to he credit of the decade 1890 to 1900, the hammer alone having been in use prior to 1890.

5. The great expansion in the use of power presses which has taken place during this decade must be credited largely to the growth of the electrical industries. The advent of the laminated armature for electric generators and motors called for accurately made punchings of sheet metal of a size and in numbers previously unknown. The power press furnished the natural method of making them, and in its development the capabilities of the machines were demonstrated as they had never been before.

6. The electric motor as a means of driving machine tools was first seriously proposed about or shortly before the middle of the decade, and was generally looked upon by mechanical men as a fad of the electrician. The innovation, nevertheless, obtained a foothold, and advantages which were not foreseen were found to attend it. It has become the accepted method of driving factories (a) which are composed of many departments, the flexibility and economy of the system in distributing power over a considerable area from a central station being here the factor of dominating importance, and (b) those which are of a nature requiring tools and machines to be located at considerable distances apart, especially if they are also to be intermittently operated. It is also making rapid progress in machine shops, to which the above limitations do not apply, though in such applications opinion regarding its merit is still unsettled. A leading controversial point is the attachment of individual motors to each machine tool *versus* group-driving of several machines through a single motor and a line shaft. There are well-defined conditions under which each method is suitable, but there is still a wide intervening field of debatable ground. As a matter of fact, in this field the individual motor is making rapid progress—more so perhaps than can be readily explained.

7. Like the increased development of power presses, the floor-plate portable tool system of attacking heavy work must be credited to the electrical industries, which in this instance, curiously enough, furnished both the work for which the system was first devised and the means for doing the work. It was the machining of the ring or magnet frame of large electric generators to which the system was first applied, and the electric motor supplied the only practicable method of driving the tools which form part of the system. The system has not yet found much application outside of electrical works, although a beginning has been made, and this growth will doubtless continue.

8. The grinding machine was first devised during the preceding decade as a means of doing superior work, but it was not long before it became evident that it was a source of economy as well as a means of securing superior workmanship. The full significance of this was, however, slow to be realized, and it was not until toward the close of the decade that the movement began toward a very marked increase in capacity, weight and power of the machine.

9. In no feature of machine-shop practice has there been greater progress in American shops during this decade than in the provision of crane facilities. Twenty years ago the absence of these facilities was a national reproach, but to-day there is undoubtedly better crane service in the United States than exists elsewhere. This development is to be credited to the electric motor, without which it is at least doubtful if the present stage of progress could ever have been reached. The mere transmission of the power required for cranes of present capacities by the old square shaft or flying rope would be a serious problem. Electricity furnishes, in fact, an ideal method of driving cranes, and the necessary installation of an electric plant for operating cranes has no doubt greatly furthered the adoption of electric power for other purposes.

10. Within the last few years discoveries have been made whereby certain classes of tool steel are made to endure cutting speeds which before were impossible. Like all other useful things, these steels have certain limitations, and it is too early to state definitely what their ultimate economic importance will be. It is reasonably certain, however, to be considerable.

The New Idea Wages Calculator.

The accompanying illustrations show a new wages calculator which is being made by the Carlton Manufacturing Company, of 76 Franklin street, New York.

The half-tone, Fig. 1, shows the general appearance and method of manipulating the machine, but, inasmuch as the figures in this illustration are obscure, we have prepared the diagram, Fig. 2, to show the figures more clearly, although, for lack of room, the entire length of the machine is not shown in this illustration.

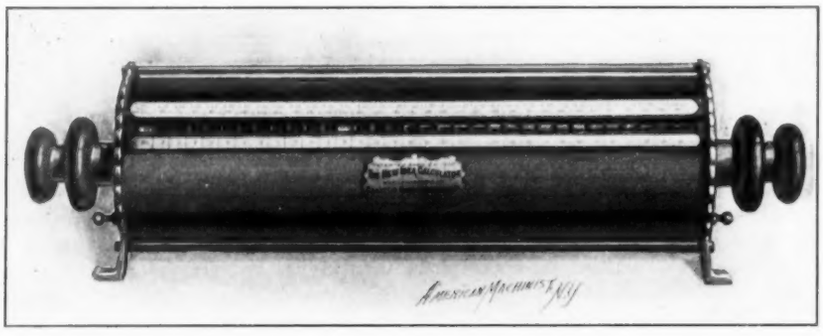


FIG. 1. NEW IDEA WAGES CALCULATOR.

Each machine is made to suit the number of work hours in a week at the factory where it is to go. In the present case the number of work hours per week is 60, but the machine gives the wages earned at the single time rate up to 66 hours per week, as indicated at the left of the upper rows of figures. The rates per half hour are shown in the lowest row of figures, this row being made to show one-quarter and three-quarters of an hour, if desired.

The machine is manipulated by the two large knobs at each end, the knobs being duplicated to enable either hand to be used. The larger knobs turn an outer cylinder on which are the upper rows of figures, giving the rates which are thus brought to view. The smaller knobs manipulate an inner cylinder on which are the number of hours worked and the amount earned during the week—this amount appearing through a window and being the only earned amount in view at the time.

In use, the larger knob is turned until the line containing the desired rate per week or per hour appears. The smaller knob is then turned until the whole hours worked by the employee during the week appear at the left, when the amount due for those hours appears at the window. Should the total time for the week include a half hour, the figure in the lowest row is added to the amount immediately above it, to obtain the total amount due. As set, the machine shows that a workman whose time for the week totals 66 hours and whose rate per week is $9.50 has earned $10.45. Had his total time been 66½ hours, the addition of 8 cents, shown immediately below $10.45, would give $10.53.

The small knob shown below the large ones is not used in manipulating the machine, but is part of a spring catch for holding the cylinder in position.

The advantages claimed over the usual wages tables are the avoidance of the turning of the pages to find the rates desired, and especially the avoidance of the necessity of tracing the columns and lines of the tables to find the amount earned. As there is but one amount exposed through its window at any one time, it is impossible to make a mistake by taking out the wrong amount.

The machine is also made for bi-weekly payments, there being in this case two pairs of cylinders arranged one above the other, the machine being thus two-storied.

1 Rate to 66 hrs.	400 $6^{2}/_{3}$	450 $7^{1}/_{2}$	500 $8^{1}/_{3}$	550 $9^{1}/_{6}$	600 10	650 $10^{5}/_{6}$	700 $11^{2}/_{3}$	750 $12^{1}/_{2}$	800 $13^{1}/_{3}$	850 $14^{1}/_{6}$	900 15	950 $15^{5}/_{6}$	1000 $16^{2}/_{3}$	1050 $17^{1}/_{2}$	1100 $18^{1}/_{3}$	1150 $19^{1}/_{6}$	1200 20	1250 $20^{5}/_{6}$	1300 $21^{2}/_{3}$	1350 $22^{1}/_{2}$	1400 $23^{1}/_{3}$	1450 $24^{1}/_{6}$	1500 25	1600 $26^{2}/_{3}$	1700 $28^{1}/_{3}$
66												10.45													
½ hrs.	3	4	4	5	5	5	6	6	7	7	8	8	8	9	9	10	10	10	11	11	12	12	13	13	14

American Machinist

FIG. 2. APPEARANCE OF FIGURES IN WAGES CALCULATOR.

Echoes from the Oil Country.

KICKS AND KICKERS.

"Jim, be very careful with that foot valve. See that you don't spring the shell in the chuck. Mind it is rather light. Be sure you get a good joint on the outside of the removable seat, and don't fail to get the valve perfectly tight; then, if your thread is nice and true, I don't see that anything could be better. Be very particular because we had some complaint about the last one."

This was a special valve used for a special purpose, and we could not afford to have them wrong, as both reputation and future trade depended on their doing the work they were designed for.

"I don't really understand it. After all the pains with that valve, here is a letter of complaint. It isn't a nice letter at all. While the writer uses good enough language, it is quite forcible in form, and the expressions used to convey his opinion of us, and of our shop practice in general and that valve in particular, are anything but comforting. To wind up with in his reflections on our work, he says he 'could throw a cat' through that valve which we passed as perfectly tight. I know that must be a little stretched, as it would be a small cat that would go through a 3-inch valve, but it must be pretty bad when such a good writer with such an important-looking heading on the paper uses such an expression.

"There is only one thing to do: we will run to-night and finish up another one and express it to him. I will have him express the other one back and save it as a horrible example to those inclined to do poor work. If they won't profit by such a warning, I think they are too far gone for me to use and we will get along without them.

"I am dead sure that last valve won't leak, as I tested it myself, and I will take a look over this one just returned and see where the trouble is.

"Well! I just wish I had the writer of this letter here a few minutes while I remarked a little to him. Any man that would allow a pair of heavy pipe tongs to be used in a brass casting about 3-16 inch thick and used by a man that didn't know enough to use them where the pipe supported the casting needs a few remarks, and any man who would see that valve after his man had maltreated it in that way and then write such a letter needed a few remarks, and if a man would write such a letter *without* seeing the valve but took the report of the man he had around he certainly needed some remarks; and I feel willing to lay off long enough to make the remarks on my own time, but really I fear that sign language would be the only kind that he would understand. I should think that the system that used a club or a No. 9 shoe would be about right."

If there is a man in charge of work who has not at some time been worke ' up with complaints just as unreasonable as the foregoing, he is either young or fortunate.

I remember once fixing an engine and doing a good job of general repairs. About three weeks after it went out the owner came rushing in greatly wrought up.

"Why in (whew!) don't you know enough to do your work right? That engine you just fixed has let go and smashed up, and here we are in the middle of win-

ter with the wells shut down. I told you I wanted things right and paid your bill without growling—and it was big enough, too—and this is the kind of work I get. I will expect you to put things right and do it quick, and if I can't get them right without this kind of thing I will have to go somewhere else. I've tried to help you along all I can, but I can't stand much of this kind of thing." And he wiped the sweat of excitement from his brow.

"I don't quite understand. What has happened?"

"I don't know just what it is, but something you overlooked has let go and smashed that engine all up. It is on the way in and will be here in a few minutes. I tell you what: I am a friend of yours, but it don't take much of this sort of thing to 'knock' a shop." And he went, leaving me feeling rather blue.

You see, I had not been in charge very long, and my orders had been very plain to "do everything right."

I had asked pointedly whether this was to be taken literally, and I was as pointedly given to understand that it was, that I was expected to see that such work as we did was as good as new, and I had tried to have it so, and, as my friend had said (and he was a good friend to me, and is yet), such things hurt.

Fortunately, I did not say anything to the men that had done the work, although the owner of the shop came in and further impressed me with the importance of not having such things happen, and told me to get rid of the man or men who let poor work go through their hands.

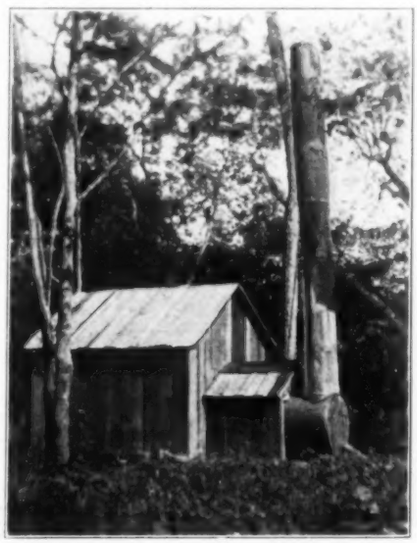
Presently, the engine came in, and it certainly was a wreck: cylinder head smashed and studs broken, piston head jammed in on one side and piston rod bent, crosshead broken and also both top guides and a nice curve in the connecting rod.

There was only one satisfactory thing left on the job, and that was the evidence to show what caused it. Along the sides of the cylinder were very plain marks to show just how high up a nice cake of ice had been and how long it was. The man had evidently been in a hurry, both in shutting down and starting up, and forgot to drain things at night and to close the valve on his boiler, and had not let it have much time to warm up in the morning.

When the owner of the engine saw it he could read things very clearly. I don't know just what happened at the "lease" when he went out, but the air in the shop was blue (bluer than I had been) for a few minutes, and it wasn't me that was catching it, either.

It may interest some to know the action of such an engine when run on a mixed diet of steam and ice. While everyone will concede that steam is pretty fair in its action, some may think that ice would not mix well with it. To make the matter as clear as possible, so that my friend who thinks the oil country a peculiar place where things happen in a way impossible elsewhere may have a chance to experiment under reasonably similar conditions, I will try to give some description of the engines used here: Unlike most engines, these are not designed to run without fluctuation in speed at various parts of the revolution, but are made with as light flywheels as can well be used. While varying somewhat for different makes, the ordinary size and weight for a 9x12-inch engine is 4½ feet diameter and 450 pounds weight. The steam pressure used in pumping is usually about 80 pounds, being higher or lower according to the work the engine has to do. The ports are large and long, and the valves are made with short travel, the whole idea being to make a very quick acting engine that can be reversed with full head of steam on and at once jump to full speed. To take care of water, the clearance, especially in the old ones, is very large.

Some engines have all of Venango county for a house, while others have a board shanty; in some cases this shanty has the cracks battened. Occasionally the shanty will be made of sheet iron nailed to studding. When the thermometer shows away below zero and such an outfit is perched on the side of a wind-swept hill, it does not need a lively imagination to make one think that it might be cold around such an engine-house. A glance at the photograph will show why one engineer realized how cold it gets. His boiler blew up one day while he was pumping off, and in explaining why, he said: "It was so blamed cold that the water in the far end of the boiler froze up solid an' burst it. You know there can't anything stand such hard weather as we've been having."



A SNUG ENGINE AND BOILER HOUSE.

The engine I was telling of did not smash up in exactly the same way, but more like this, I think: The engine stopped with the slide valve partly open and the piston a short distance from the end of the cylinder. The throttle valve sets on the cylinder, and, with steam on the boiler all night (gas is used and enough is left turned on to hold the steam as a usual thing), it would leak a little through into the cylinder. Even if the pet cocks were open, as things cooled down it would freeze and what had gathered around the head would freeze it hard to the cylinder and hold it tight and the cylinder would partly fill up. In the morning when the man turned on the steam and things did not move, he would as likely as not throw the throttle wide open, when the ice melted enough to let go of the head that engine would go with a jump, and by the time the head got out and back again to the ice it would be ready for business. Had it met only water instead of ice no harm would have been done by the sudden start. If the clearance had not been enough to take care of the water, and some have as much as 1½ inches on each end of a 12-inch stroke, the valve would be forced from its seat and so take care of it.

The engine was seen by a number of thoroughly practical men, and they all agreed without hesitation as to the cause. It took the owner just about one minute to decide that the shop was not to blame. To my inquiry, when the engine came in, as to what had happened, the man that had hauled it in replied: "Looks as if the pumper laid in bed too long and was in a big hurry to get started."

I do not know how much speed would be necessary to do the damage I have described, but I do know that a very little speed that is tried to be checked instantly can act very strongly. To have a combination that could be left alone for a long time without fear of its not holding, I once designed a clutch with a positive locking device. When the first one was put on an engine I tested its locking qualities. I put a fair load on, and, wishing to see how much of a jar it would cause if the locking device was thrown in before the load was quite up to speed, I threw it in. I didn't feel any jar, but I did have to build a new clutch to pay for my experience, and that clutch had been made to stand rough usage and had a large factor of safety as compared with the working strength of the engine. I realized that the striking force was another thing entirely, and that it was not weakened any by the toggle action of the crank and connecting rod as the center is approached.

I would not like to try to stop an engine on a solid piece between the piston head and cylinder if the piece was just thick enough to keep the engine from turning over the center and the engine only had motion from my weight on the flywheel.

I don't recall a time that I was sorry for not going after a man for bad work until I had a full opportunity to investigate, and fuller experience has increased my caution in that direction. Especially in the case of complaint from outside I find "there is luck in leisure."

"I want you to rebabbitt this box just as quick as you can. I will wait for it. Be sure you get an oil hole clear through this time. My man says you didn't run the drill clear through, so the oil couldn't get in and the babbitt melted out."

I didn't say anything to the man who was to do the babbitting about the oil hole, but asked the owner of the box how long he had used it.

"About four or five months," he replied.

"The man that looked after it is the man I have been looking for. I will pay him well if he will tell me how he used it that long without oil, and also tell me why it got hot and melted out now after so long," I remarked cheerfully.

He looked at me a minute. "I guess he was lying a little, wasn't he? But how did the oil holes get full of babbitt? I know they were full."

"It went there because it was easier going there than to go anywhere else. When it gets hot and soft it tries to get away from the pressure." And just in connection with this I had that fact impressed strongly upon me.

"What will make a box melt out with a big stream of oil going on it?" The man that asked that question was honest clear through, and was really looking for information and had just had such an experience. A little questioning showed that he had had a warm box the night before, not enough to throw the babbitt but evidently enough to soften it and fill the oil holes, and had not examined it very closely. I imagine it would take quite a big stream of oil on the outside of a box to make up for the lack of a very small stream on the inside, and he saw the point, too, as soon as I mentioned it.

Good honest kicking is all right if done where it belongs. It relieves the mind on one side and acts as a stimulant on the other side. Some kicking isn't so honest, and that kind often acts as an irritant. I wasn't boss at the time this little event took place, but was doing the work.

"Here is a man with a job he wants done in time to catch the 3.30 train. Can you get it done?" The foreman was away and the bookkeeper had brought the job to me.

"That is pretty quick time. Very little over two hours, but I'll do the best I can." And I went to work, sparing neither file, chisel nor hard work, and I had it ready a few minutes before train time, and the man took it and went into the office.

The bookkeeper quickly appeared and asked me if I had used any material.

"No, but how much time are you charging on that job?" said I.

"Two hours," he replied.

"I'm going to charge in more than that. I've got to fix up a lot of chisels and will take it easy for awhile to make up for the rush, and he should pay for it. You had better charge him $1.25 for the job."

So he did, and was soon back with the man along.

"What do you mean, anyhow? You only worked two hours on that job, and I never had to pay more than 45 cents an hour for work, and most of the time I got it for 40 cents (the train pulled out and was gone, but he did not notice it). You mustn't think I'm a greenhorn because I come from a sawmill."

"I think that is cheap enough at a dollar and a quarter, and besides I had it done soon enough to let you catch your train and get home and get your mill going." I tried to talk soothingly.

"I won't pay any such price—why that is 62½ cents an hour. Here comes the foreman. He'll fix it."

The foreman came up and looked the job over (he evidently knew the *man*) while the man poured out his complaints. Turning to me he said: "Did you tell this man he could have this job for $1.25?"

"Yes, I thought it was worth that," I answered meekly.

"I should say it was worth it. If you told him that I suppose I will have to stand by it, but if I had been here he would have paid at least $2 for it."

Turning to the man, he added: "We only let this man work for our best customers, and they are glad to get him at any price."

As the man shuffled into the office, he added to me: "That fellow wasn't in a hurry; he only wanted to work you for a cheap job. I know him, confound him."

W. OSBORNE.

Recording Prices of Goods Purchased For a Specific Use.

BY KENNETH FALCONER.

The plan here described was designed to meet certain requiremnts, and to overcome certain difficulties where the conditions were perhaps too unusual for it to be generally applicable. A description of it, however, may prove useful to those who, while keeping accurate record of the prices paid for stores in general use, find a difficulty in keeping track of the many articles which have been especially purchased for some specific purpose.

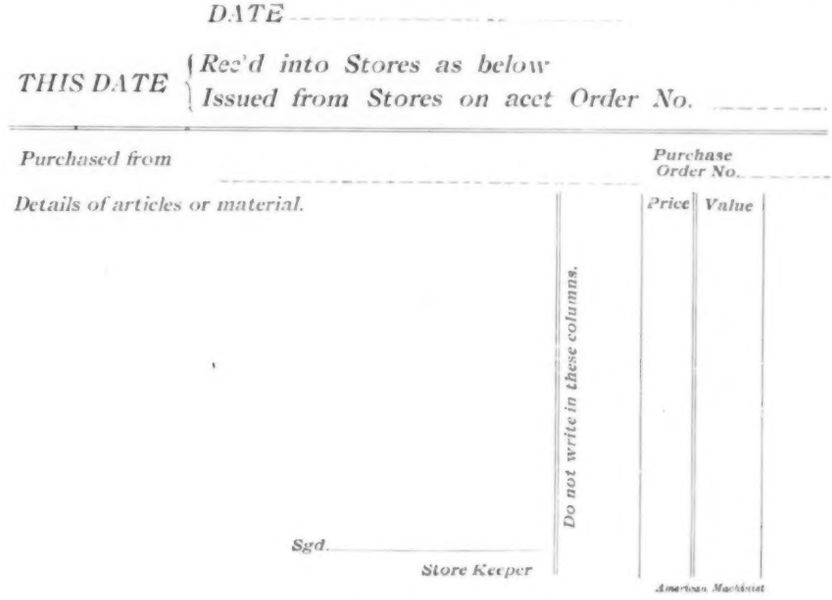
A manufacturing company doing business in the suburbs of a large city found it more advantageous to procure a large number of their supplies in the quantities immediately required by each shop. On receipt, such supplies are delivered, in the quantity purchased, to the shop for which they are intended. In addition to this, most of the product being made for special orders, the bulk of the trimmings—in fact, all required for the best class of work, such as door handles, hinges, locks, etc., is purchased in the quantities required for specific orders, only the cheaper goods being carried on hand. The pricing department was thus "betwen the Devil and the deep sea." Keeping record of purchased goods on a card index, they had to choose between burdening that index with the record of many articles to which reference would have to be made but once, or, on the other hand, using the invoice file as a sort of auxiliary price list. The former, besides occupying too much time, was found to largely destroy the usefulness of the price list by swamping the records of material regularly purchased and kept on hand under those of many articles which, when once charged to the order for which they were procured, were of no further use or interest. The alternative plan of using the invoice, besides being inconvenient and entailing loss of time, was made still more difficult by the delay frequently experienced in receipt of invoice for goods so purchased. The operating conditions were simply that no goods whatever were supplied from stores without being charged up to an order number; if not a manufacturing, then a shop order, and that the charge slips for such goods were sent at stated hours each day to the office to be priced and posted. On receipt of goods by the stores department they were entered in a Stores Received book from which the invoices were checked later. These were the conditions to be met, with the added requirement that the cost department was expected to keep records of both material and labor in such shape that the accountants could each day tell the cost of any order up to the time of quitting the day previous, and they were also expected to be able to give prompt information as to the prices at which goods were purchased. Following is the plan adopted to meet these conditions and requirements, and incidentally to increase rather than to lessen the accuracy of the costs whether of manufacturing or of shop orders.

The store-keeper was given a book of purchase orders having a prefix to their numbers in order to distinguish them from orders for the purchase of regular stores; these were to be used only for such articles or goods as were required for some specific order, either shop or manufacturing, and which, on receipt, were to be sent at once to the shop or department calling for them. Instead of such goods or articles being entered in the regular Stores Received book, they are entered in a book called the Special Stores Book, Form 1. This is a small book bound and numbered in duplicate, with the second sheet of extra stiff manilla and perforated for removal. These sheets are exactly 6x4 inches, the size of the card index in the office, and are of such color that they are easily seen when placed among the white cards of the pricing clerk's index. On receipt of any special stores, this form is made out by the use of carbon paper, the store-keeper retaining the book as a record of the goods received by which to check the invoices, and the manilla copy being sent to the office with the charge slips for stores issued. This form, quoting the number of order to which the goods are to be charged, it will be seen that the copy

in the stores department (the record of receipt) and that sent to the office (the record of issue) which has now become a charge slip, offset one another, and there is no need for either to go through the Stores Ledger, if one is kept. On receipt of Form 1 by the office, it is at once entered up against the order whose number it bears, the price being left blank. It is then filed away in the regular card index or price list of material purchased which is arranged on the usual lines of a card price list.

From time to time the invoices (quantities and prices having been checked from the Stores Received and Special Stores books) are sent to the pricing clerk to be put on record. The purchase order number on each will show him at once if the goods are for regular stores or for some individual order. The former he enters on the cards in the usual way, but the prices of the latter, instead of being retity or bulk for use on some specific order, the price list contains the manilla slip representing *only those the cost of which has not yet been entered up against such order,* similar slips containing the record of other purchases which have been charged up against the order upon which they were used having been removed at the time the charge was made.

An examination will show that saving has been effected in more than one direction; in the first place the store-keeper, in so far as these especially purchased goods are concerned, now takes record of their receipt and makes out a charge for their issue with the one writing. Formerly he first entered them in the Stores Received book and then made out a charge slip against the order upon authority of which he issued them to a shop or department. The pricing clerk's work is facilitated inas much as while keeping full record of these articl s he has only to note on his index the



FORM I. A PAGE OF THE SPECIAL STORES BOOK.

corded on the regular card, are noted on the manilla slip, which, owing to its color, he can readily see. After noting the price he turns up the book or sheet on which is kept the cost of the order on which the goods have been used, and to which they have already been charged, the price having been left blank. He now fills in the price and value. The slip showing receipt of the goods has now served its purpose, and *is not returned to the card index,* but may be destroyed, though it is preferable to file it away in transfer cases arranged on lines similar to the card index.

It will now be seen that the card price list contains two classes of records. On regular cards will be found the particulars of all purchases of materials which are usually kept on hand and issued by the stores in varying quantities. As regards articles or materials which stores received and at once issued again in unbroken quanprices as shown on invoices instead of all particulars, such as name of supplier, date, etc. As regards the card price list, it is as efficient as though it contained the records of every purchase, while at the same time records of value and to which frequent reference will be made are not buried among a mass of miscellaneous information of no possible importance. Its increased usefulness is in direct proportion to the number of purchases of this special nature, which in the case under consideration was considerable.

As the invoices reach the pricing clerk the number of the purchase order on each will indicate if the goods were purchased for regular stores or for use on some specific order. In the former case the price and all particulars are entered on regular price cards; in the latter case a manilla slip containing all particulars except the price will be found in its proper place in the index. This slip also shows the number of the order to which the goods have been charged, and on which the price is to be filled in. This being done and the price noted on the slip, the mere fact that it is that particular form tells the pricing clerk that the record is of no further use as far as the pricing list is concerned and is not to be replaced therein. This plan practically makes the card index a price list of stores on hand rather than a record of the prices at which all materials have been purchased, and to the extent to which it does this it facilitates pricing up each day's charge slips and lessens the chances of error. It is, however, supplemented by such of these slips for special goods as will have to be referred to in order to obtain the cost. These slips form a price list, it will be noticed, not of all stores or material purchased and used for specific purposes, but only of a very small proportion of them.

In addition to these direct gains, in many cases more accurate costs are obtained. For various reasons it may be necessary at times to purchase in the local market articles or materials similar to those usually bought in larger quantities at a lower price; the supply on hand may be exhausted, or may not meet some requirement of shape or size; in such cases the probability is that even with an extremely careful pricing clerk the goods so purchased will be, more or less often, charged out at the recorded cost of similar goods regularly bought at a lower figure. For instance, assume that 3-inch heavy spring hinges are imported at a certain price, and that, a special color or finish being required, a quantity is bought in the local market at a higher price for a certain order. If both these purchases are recorded on the card for hinges of that particular size and a charge slip goes through in the usual way, there is nothing to indicate to the pricing clerk which particular hinge has been issued. If the plan here described is in use, the very form on which the charge against the order is made notifies the pricing clerk which of the two costs to use.

Individually, these are all small matters, but collectively they may considerably affect the expenses of the cost department, the usefulness of its records and the accuracy of the information which it supplies.

Montreal.

A Simple Method of Perspective Drawing.

BY LAWFORD H. FRY.

Many mechanical draftsmen regard perspective drawing as an art outside their line of work and as involving abstruse and unfamiliar principles. There seems to be no good reason for this, except that perspective drawing is not always included in a course of instruction in mechanical drawing, and that when taught the really simple nature of the work is not always disclosed.

In an editorial in the AMERICAN MA-

CHINIST, published at page 1248, it was pointed out that a perspective drawing of a design is often useful, as it will give information regarding the general appearance which cannot be obtained from the flat projections used in mechanical work. In the course of the present article it will be shown that a perspective drawing can be made by a simple application of principles which are used in all mechanical drawing.

An ordinary mechanical drawing and a perspective drawing are both plane projections of the object drawn, but in an ordinary drawing the projecting lines are parallel, while for a perspective drawing the projection is carried out by lines radiating from the observer's eye. This projection can be made on a plane at any angle with regard to the observer, but it is desirable to choose a plane having the same position in relation to the observer as the perspective drawing will have when finished. A drawing is usually examined with the line of vision normal to its surface, so that in making a perspective view it is desirable to choose a projection or "picture plane" approximately normal to the center line of vision. Strictly speaking, the angle of clear vision is small, so that in looking at an object the direction of vision is frequently shifted, and the object is seen as though projected on several planes. Usually, however, the distance between the eye and the object is large compared with the greatest dimension of the object, and the movement of the eye is so slight that the resulting change of the picture plane may be neglected and the drawing made as a projection of the whole object on one plane. To avoid a distorted appearance, care must be taken, when making a drawing, to have sufficient distance between the eye and the object. The distance of the eye from the nearest point of the object should not be less than one and one-half times the greatest dimension of the object.

The illustrations show the process of constructing a perspective view of an object, of which the horizontal and vertical projections are given. Take, for example, the object shown in Fig. 1. The observer's position is chosen with regard to the part of the object it is desired to see. For a general view the eye is placed at a point having E' for horizontal and E'' for

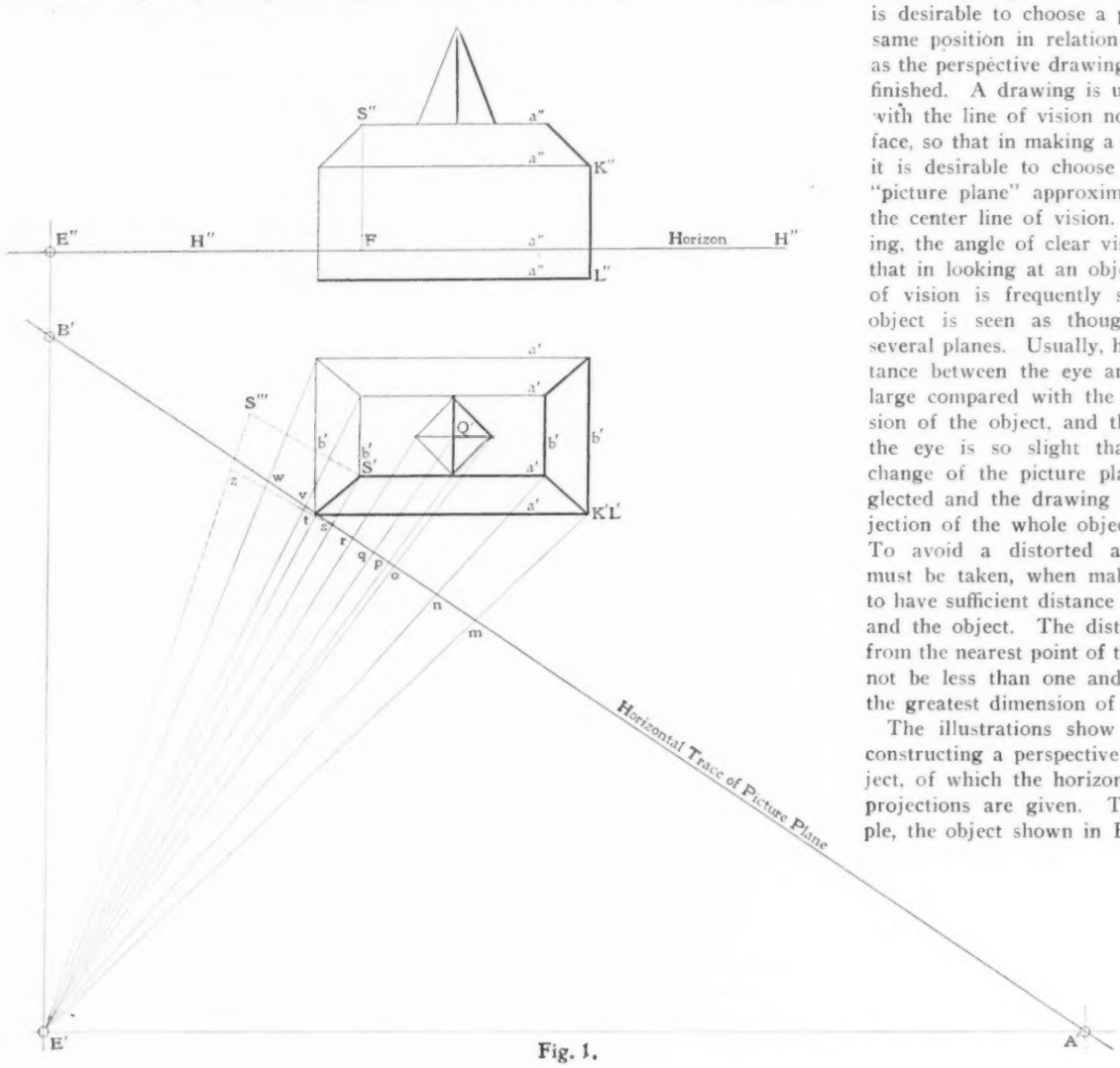


Fig. 1.

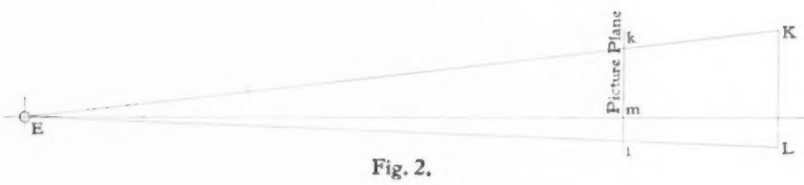


Fig. 2.

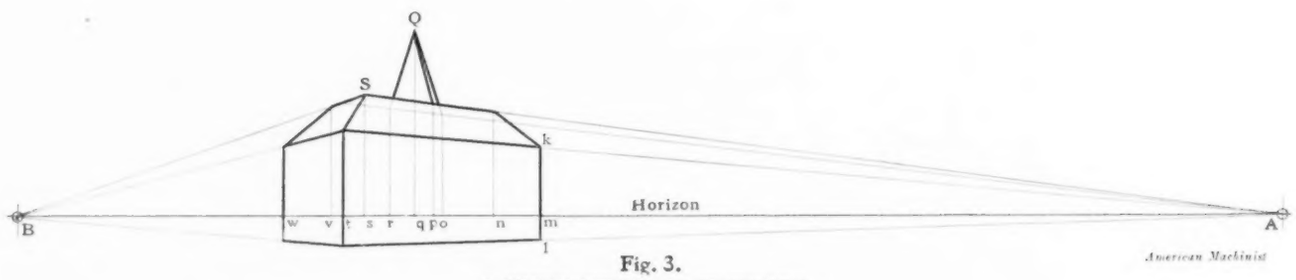


Fig. 3.

A SIMPLE METHOD OF PERSPECTIVE.

vertical projection. The horizontal line H'' H' drawn through E'', the vertical projection of the eye, gives the apparent hight of the horizon—that is, the line in which all horizontal planes appear to meet.

In order to give a proper effect, it is generally desirable to choose the observer's position, so that the longer side subtends to him a greater angle than the shorter side.

A vertical picture plane is now chosen approximately perpendicular to the line from the eye to the center of the horizontal projection. In the present case A' B' is the trace of the picture plane in the horizontal projection. The construction is slightly facilitated if the picture plane cuts the object, and therefore in the present case the plane is laid through one corner of the object. The object chosen has three prominent sets of parallel lines, one set being vertical and two horizontal. The horizontal sets are at right angles to each other and are marked in the horizontal projection respectively a' a' a' and b' b' b'. It is of course a matter of common experience that the lines of each of these sets appear to run together to a point, and the next step in the construction of the drawing is to find where these "vanishing points" appear in the picture. If a line is drawn through the eye parallel to the a lines, its horizontal projection will be E' A' parallel to a' a' a', and its vertical projection will be E'' H'', since the a lines are horizontal. Now this line, being parallel with the a lines, will appear to meet with them in their apparent meeting or vanishing point. Consequently, the apparent position of the vanishing point for a set of parallel lines is the point in which a line drawn through the eye parallel to them meets the picture plane. The horizontal projections of the vanishing point for the a lines is hence A'. Similarly is found B', the horizontal projection of the vanishing point of the b lines. The vertical lines do not appear to converge, because, being parallel to the vertical picture plane, a line through the eye parallel to them would not meet the picture plane.

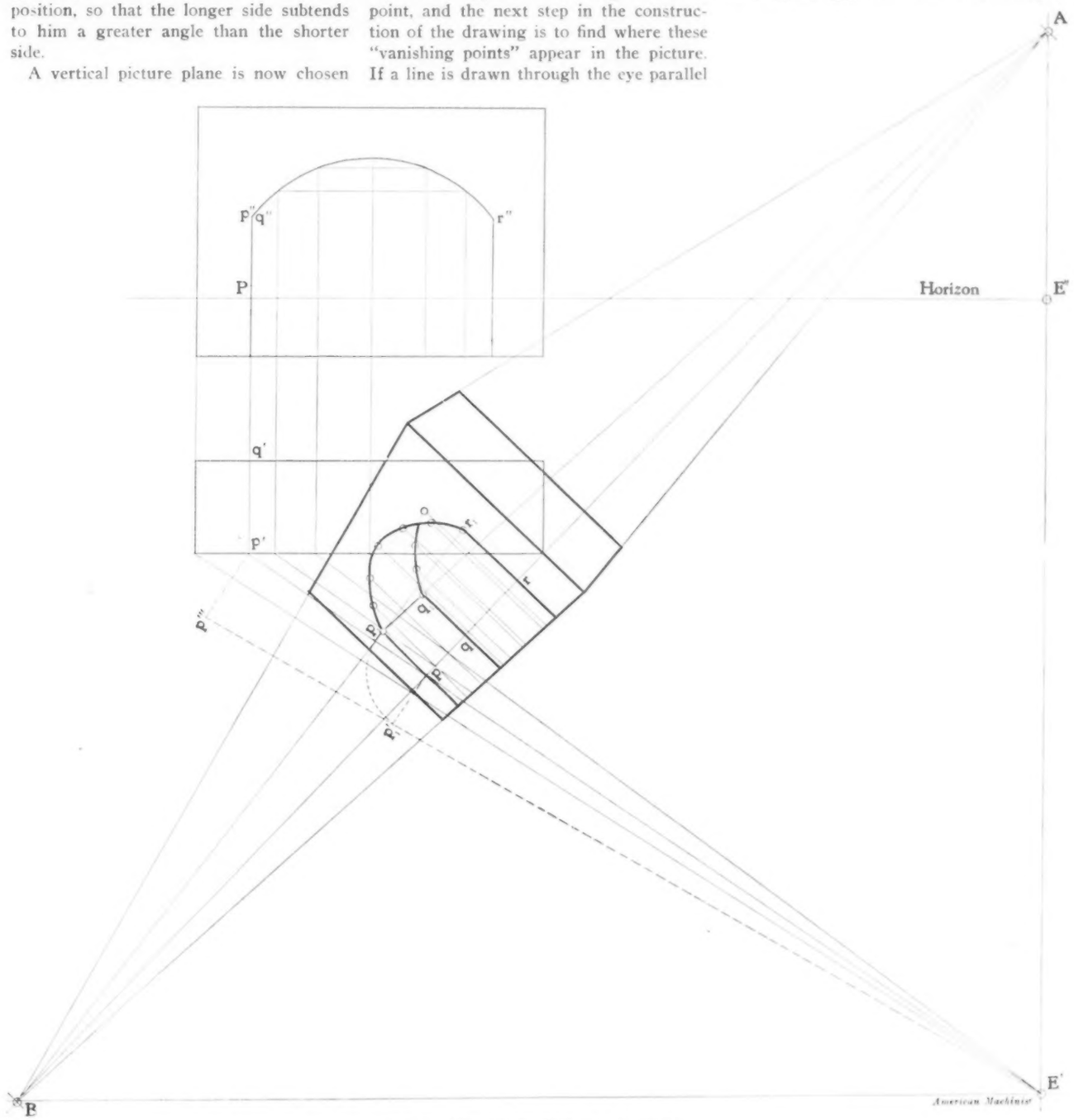


FIG. 4. THE PERSPECTIVE OF AN ARCH.

In looking up at an object of considerable hight, the head is thrown back and the picture plane* remaining normal to the center line of vision is no longer vertical, so that the vertical lines of the object, not

* Not here the plane on which a picture is drawn, but a supposed plane to which the eye refers the actual object—Ed.

being parallel to the picture plane, appear to converge. If the observer is placed so that the picture plane is parallel to one of the faces of the object, all parallel lines in this face, both horizontal and vertical, will appear parallel in the perspective picture. This position is, however, so seldom attained in reality that a perspective drawing from such a point of view could not appear natural.

It follows that since all vertical lines of the object reappear in the picture as verticals, the simplest method of constructing the perspective picture is to choose those vertical lines which determine the outline of the object and then to find the apparent position and length of these lines. To do this by the method explained below will be found to be a very simple matter. Take, for example, the line $K''L''$ in Fig. 1. By joining the horizontal projection of this line (the point $K'L'$) to the horizontal projection of the eye (E'), the actual distance of the line from the eye is found and the apparent position of the line in relation to the vanishing points is determined by the point m. Then, if a vertical section, as in Fig. 2, be drawn through the line $m E'$, the eye, the picture plane and the line $K L$ will all appear in their proper relative positions. The apparent length of $K L$ is obtained by projecting the points K and L on to the picture plane by lines through E, thus obtaining the points k and l. The horizontal line $E m$ determines the point m, in which the vertical line appears to cross the horizon. The apparent hight of $K L$ being found from Fig. 2, and its apparent position from Fig. 1, these are laid down in Fig. 3, as shown. The horizon $A B$ is drawn and the vanishing points A and B are marked, the distance between them being that found in Fig. 1. The point m is marked in the same relative position as in Fig. 1, and the line $k l$ drawn of the length found in Fig. 2.

These simple processes cover the whole art and mystery of perspective drawing. The view of the whole object is constructed by the repeated application of the above process to determine the apparent positio. and length of the vertical lines which mark the salient points and outlines of the object. Figs. 1 and 3 show the construction as carried out. The horizontal projections of the vertical lines required are joined to the horizontal projection of the eye, the lines thus drawn cutting the trace of the picture plane in m, n, o, p, etc. These points are laid off in Fig. 3 and vertical lines are drawn through them. Where necessary the apparent hight of these lines is determined as in Fig. 2. In order to save work it is often convenient to determine the apparent length on Fig. 1 by the construction shown in broken lines for the vertical S. $S' S'''$ is drawn perpendicular to $E' S'$, and is made of the same length as $S'' F$. Then S''' is joined to E' and $s z$ is drawn through perpendicular to $E' s$, meeting $E' S'''$ in z; $s z$ is the apparent hight of the point S above the horizon. It will be evident from the figure that it is not necessary to determine by construction the hight of all the vertical lines. As the line t lies actually in the picture plane, it appears in the drawing to have the same length as it has in the vertical projection. The horizontal lines through the ends of this line appear to meet, as shown, the a lines in A and the b lines in B; so that, by joining the ends of the line t to A and B, the lengths of the lines w and m are determined. Similarly, having found the apparent position of the point S and joining it to A and B, the lengths of the lines v and n are determined. The diagonal lines are drawn connecting the points found for the apparent positions of their ends. As the perspective view is a plane projection, all lines which are straight in the object will reappear as straight lines in the picture.

It will be seen that the whole process is simple in the extreme, and that the method used is capable of application to any object. If the object to be drawn is composed of curved lines, the apparent positions of a number of points on the curve are determined by finding the apparent length and position of vertical lines terminating in the points.

As an instance of the procedure in such cases, an illustration is given in Fig. 4 of the construction of the perspective view of an arch. In this drawing the whole process has been carried out in one figure, the vertical and horizontal projections being drawn in light lines and the perspective view being drawn in heavily. By this means the transference of distances from one figure to another is avoided. The apparent positions of the various verticals is found, as described above, by the intersections on the horizontal trace of the picture plane, and this line is then taken as the apparent horizon and lines perpendicular to it are drawn through the intersections, thus giving the apparent positions of the verticals. To avoid confusion in the figure the radial lines determining the positions are shown for only the first four verticals counting from the left hand. The perspective view of the curve is constructed by determining the apparent hight of verticals terminating in the curve. The verticals used are indicated in the vertical projection by light construction lines, and in the perspective view the apparent positions of their ends are marked by circles. The full construction for three of these verticals is shown, and it will be seen that by choosing the verticals properly the construction is much simplified. The determination of the verticals p, q and r is shown. The line $p' p'''$ is drawn perpendicular to $p' E'$ and equal in length to $P p''$, and $p p_1'$ is drawn perpendicular to $p' E'$. Then $p p_1$ being set off equal to $p p'_1$ gives the apparent hight. By joining $B p_1$ and producing the line to r_1 the apparent hight $r r_1$ is found, and similarly by joining $A p_1$ the apparent hight $q q_1$ is found. From this it will be seen that by a symmetrical choice of verticals a single hight determination gives, by the aid of the vanishing points, two other apparent hights. The same process repeated for the other verticals gives the desired perspective view.

Letters From Practical Men.

Arrangement for Boring Crank Disks.

Editor American Machinist:

In the description of an arrangement for boring crank pin holes, at page 1267, the credit should be given Mr. Vogel, the latheman, and to Mr. Woodward. Careless writing has doubtless been the cause of the insertion of the one pronoun "I" whereby the writer apparently states that the device is his design. JOSEPH S. REID.

Habits and Machine Design.

Editor American Machinist:

My respect for Professor Sweet is so great that I always feel quite surprised when I find myself differing from him on any subject; but I do most emphatically take issue with him when he says, at page 1491, that a tail-spindle screw operated by a hand-wheel should be a right-hand screw, while if it is turned by a crank handle it should be left-hand.

I was up against that proposition practically in a shop where I had to use two lathes, one of which had a right-hand tail screw and the other a left. Both had wheels, so there was a good chance to decide which was the more desirable, without mixing in the question of difference in style of handles. I found that on changing from one machine to the other I invariably had trouble, and I am quite certain that a difference in the style of handle would not have lessened the difficulty.

Drilling by pulling on the bottom of the wheel is quite as easy and natural as by pulling on the top, and the great desideratum is to have the machines so constructed that similar movements will produce like results in all. The natural movement is the one which will act on the tool as though it were at the tip of a right-hand screw moving in a fixed nut, and so long as tool builders bear this in mind they will give little cause for complaint to the tool users.

While we are on this subject I want to enter an emphatic protest against that abomination so often found on otherwise excellent machines—the unbalanced handle. Most of us have at one time or another experienced the vexatious results of an unbalanced handle which dropped down and spoiled a piece of work. Of course on American lathes it is found only in one form, namely, the wheel with a handle, as the plain crank is too barbarous for us, except on an occasional compound rest, where it is usually removed by the lathe hand to prevent its doing any mischief. I know of several lathes whose hand-wheels have been balanced by the users, and at least one of our builders has

been wise enough to cast his wheels with a counterbalance.

My worst trouble has been with shapers, for on them there seems to be no rule for the cross-feed screws, and I have often had to lose a lot of time figuring on which way to turn the crank. I think the screws should be left hand.

Drill presses trouble me quite a lot, as regards the shippers, which are arranged without any attempt at uniformity. To be logical, a push toward the column should start the machine, yet it seems more natural to me to have them work the other way, simply because I have used more of them that were arranged to start by pulling and stop by pushing.

All this is practical machine design, so it is quite in order for me to find fault with another feature of the design of upright drills, and that is, the back brace. This feature of the machine is intended primarily as a support for the back bearing of the top shaft, and should therefore be a straight post extending from the base to the bearing it supports. Instead of this it is invariably a crooked support for the middle of the bracket which carries the bearing, and it is not only much less effective as a support than it should be, but is frequently in the way when shifting the belt from one speed to another. Moreover it is always ugly.

Now then, there are the countershaft cones of lathes and shapers. I have lost lots of time and been sadly tempted to say wicked words through stiff belts going off the end of the cone. So has everybody else. Yet, in spite of this, tool builders don't put flanges on those cones. Why not? I am sure I don't know, neither do the builders. They wouldn't cost much, and they would be a good talking point. Besides, the great army of workers would rise up and call him blessed who put the flanges on.

Talking about countershafts reminds me of the way the backing-belt question is settled at the Boyer plant of the Chicago Pneumatic Tool Company. They leave the belt off and in its place put on a spring-tightened leather band brake. Throwing the clutch into the pulley with the brake gives a much quicker stop than otherwise could be obtained, and the device is much liked by the employees.

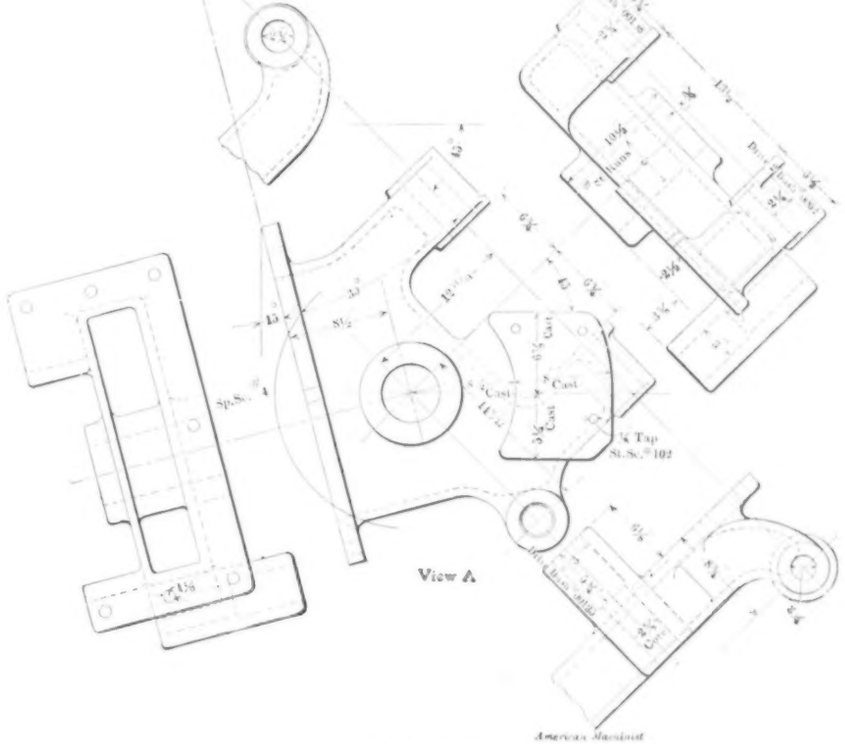
Detroit, Mich. L. O. DANSE.

A New Phase of Machine Design.

Editor American Machinist:

When I read the article on "A New Phase of Machine Design," at page 1486, I did not smile this time, nor did I get mad, but I have serious objections to Mr. W. H. S.'s practice of the "new phase."

First, no draftsman should expect a blacksmith to make a correct forging from an incomplete drawing. In the sketch which Mr. W. H. S. uses as an example, only two views are shown; the end view, which is as important as any, he carefully avoids, because, if a correct drawing is made of this piece, giving the front, the top and an end view, any blacksmith who is used to work from drawings will be able to make this forging without asking for any further information. But if a blacksmith is not accustomed to work from drawings and does not understand them, he will not understand a perspective sketch because he will not be able to see a subject on paper; all he sees is—*lines*. In this case I would not give him a drawing of any kind, but instead I would have a piece of band iron bent to the desired shape, and after having figured the length of the forging when straight I would tell him to take a piece of steel so wide, so thick and so long, and forge it in shape like this, handing him the piece of band iron.



A DIFFICULT PIECE TO SHOW.

In the sketch of the base of a power hammer, Mr. W. H. S. tries to show everything in *one* view. If the three necessary views of the base are shown, any man who understands his business can see what is wanted. But as he goes on defending the "new phase" he says in the mechanical drawing the base "looks weak, thin, out of proportion," and in the perspective view it begins to "fat up" and looks strong. To this argument I hang a danger signal to warn every designer not to use this method to design important parts of machines, because if a part so designed would come to perform its duty it may give way because in the "new phase" drawing it only *looked* fat, but in reality it was not fat enough.

Enclosed you will find two blueprints* of a bracket—one right-hand, the other left-hand—which is my design, and the detail drawings were made according to my instructions. The view *A* is the only one in which this bracket can be represented in a mechanical drawing manner. Any other view from this one will involve difficult projections—too much of the "new phase" method. You will notice how I got around making these projections by placing the top view right angled over the top of view *A* but leaving the bottom off, the bottom view right angled under the bottom but leaving the top off, and in the end views showing only what pertains to the respective ends. After the drawing for the right-hand bracket was finished on bond paper, it was turned upside down and traced, and in this manner a correct drawing of the left-hand bracket was made, relieving the draftsman of the labor of transferring everything from right to left in his mind before drawing it on paper. It required, not merely three, but five views to *mechanically* represent this bracket on paper, and any patternmaker who does not understand these drawings does not understand his business. You see, I find the drawings as well as the arguments of W. H. S. very incomplete; even the name at the end of the article is incomplete.

For the reasons described above I again declare the "new phase" as impracticable.

JULIUS KREIS.

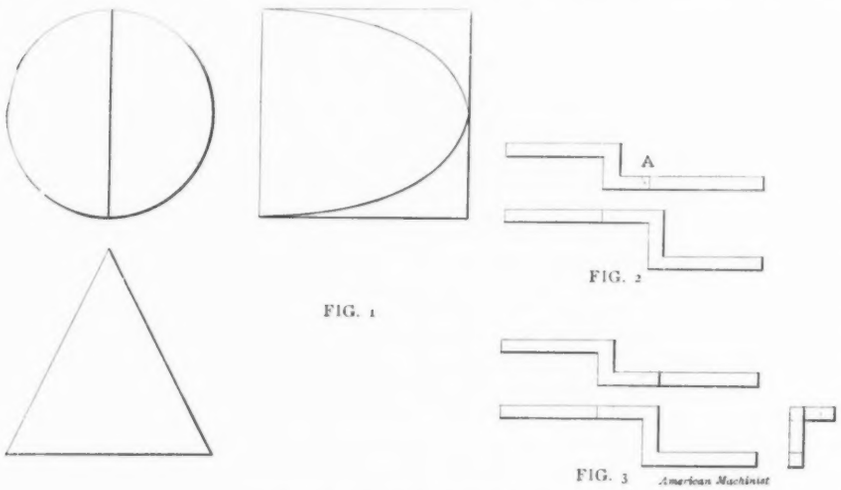
* We reproduce but one.—ED.

A New Phase of Machine Design.

Editor American Machinist:

A correspondent at page 1487 says that the three views, Fig. 1, page 1486, represent the three holes that will be exactly filled by the block shown in Fig. 2. I do not see why the line is across the circle in Fig. 1 if it represents a circular hole. Also it seems to me that the shade lines on the other two views are wrong if they are to represent holes. On the other hand, if these views are to represent the block, they are not correct, because the square shown should have a curve running from the upper left-hand corner to the base and back to the lower left-hand corner, as shown at Fig. 1 enclosed herewith.

The two views shown in your correspondent's Fig. 3 I should think might be a puzzle for any man—for they are not correctly drawn. The line marked *A* in the enclosed sketches is in the wrong place. The correct way to draw the piece is shown in Fig. 3 of the sheet enclosed,



CORRECTED DRAWING OF THE PUZZLES.

which not alone gives the man three views of the piece, but shows him by dotted lines the parts which are behind. It must be a complicated piece indeed which cannot be shown by three views in mechanical drawing—when they are drawn correctly. I do not, however, wish to infer that a complete machine can be shown in three views. In that case sections may be necessary. Perspective, while it may give a good idea of the way a machine will look, is not, to my thinking, an absolute necessity. J. W. B.

Different Views of a Machine Shop Job.

Editor American Machinist:

I had two solid weeks of vacation this year in which I conscientiously tried to avoid as completely as possible the experiences of my other fifty weeks' routine. I was out of sight of a brick and a newspaper, and my eyes were filled with trees and rocks and broad reaches of changing water. A certain sense of obligation to a friend led me into just one machine shop, and there I saw one thing that seemed to me worthy of special mention in the columns of the AMERICAN MACHINIST, and this not so much for itself as for what it might be made to suggest.

The thing that I saw was a flywheel 8 feet in diameter and weighing more than a ton and a half swung on the face-plate of a 36-inch lathe to be not only bored but turned on the rim. It was a gap lathe swinging 66 inches in the gap, and headstock and footstock had been blocked up about 15 inches to swing the wheel in the gap. It had been necessary to build out a platform for the column that carried the compound rest that was to do the turning of the rim. The lathe was an old one and not as heavy as the usual 36-inch lathe of the present day would be when designed only for 36-inch work at the utmost, so that the drive of the lathe, besides everything else, was painfully inadequate for the task that was put upon it. They were only boring the hole when I came along, and had not begun the turning, but I was quite content to imagine the operation. I think I would certainly have turned the rim first and then bored the hole, so as to be sure that if there was any shifting during the turning of the rim the hole would be true with it. Possibly they were only roughing out the hole when I saw it and were going to finish it later, which would have been all right as far as that was concerned.

Now, I couldn't help thinking over and over again about that job and about the different views of it that might be held by the different ones that directly or indirectly had to do with it or should happen to see it.

There was the shop proprietor or manager to begin with. It must be pretty evident on the face of it that he was no practical mechanic. It must be remembered that this was no emergency job, such as might have come to Mr. Osborne in the Oil Country, which it would have been all right for him to do and which we know very well he would have done all right. There were two of these wheels to be done at this time, and there were likely to be others at any time in the regular line of work. The shop was entirely new, and this gap lathe had just been moved into it from a shop previously occupied and placed in position under the traveling crane as one of the regular tools. I didn't need more than the sight of this tool so placed and this job in it to warrant me in assuming as I did that the head man who had the say about things was not a practical and experienced mechanic. I say this in perfect safety and innocence because I do not know who or what he is. I have no doubt that he was congratulating himself upon his success in compelling the doing of that job in the way and with the means described. Of course he had been told that he ought to get a good boring and turning mill of suitable size for such jobs as this and that they could not be done without it and he can take the actual doing of the job as his vindication. "They said the job couldn't be done, but I don't see but what it comes out all right. You can get most anything out of those machine-shop fellows if you stick to it." It is not likely that he will look up the time taken to do the wheel, but when the entire machine is finished, then he will be able to jump on it as a whole. It happens that the doing of the wheel was only a sample of the way things were compelled to be done in that shop, and yet the boss no doubt will be remarking that he "don't see why we can't turn out work as quick and cheap as they do it in other shops," and he may go further than that and blame the foreman and the workmen for it all.

The foreman, of course, all the while has his own view of things and a very different story to tell. He no doubt has had his say about the necessity of having proper tools to do the work, and knows how much attention has been given to his words. It would be very strange if all ambition and pride in achievement were not killed out of him. He will be likely to settle down, in a way more or less pronounced, of letting things go as they will and his men will take their cue from him.

As to the view the men of the shop might take of this particular job and of this style of doing work, I can imagine that quite a difference might be found. I suppose some men might think it all right. They might consider that this boss, whether consciously and intentionally or not, was promoting the interests of the workingman. There would be no danger of his making work scarce by getting each or any workman to do too much of it. The same amount of work would certainly keep the same number of men longer employed in this shop than in one where all the tools were of the best precisely adapted to the special work to be done and accompanied with all the modern appurtenances for handling and turning out the

work. This style of men would be likely to be found in this style of shop.

There are other workmen who, as I happen to know, would be quite certain to think differently and who would be likely to act upon their convictions. They take pleasure and pride in doing a good day's work, and in the long run they insist upon the means and conditions which will permit it. They want the best wages that are going, and are more than willing to earn them, and they cannot regard with any complaisance the employer who deliberately and persistently insists upon their working so that they cannot do a fair day's work. It is not easy to trace entirely the way things operate, but it is very certain that you do not find the best workmen staying long in the shops where the old or inadequate tools compel ineffective methods and restrain the doing of work at the rate to which the men have been accustomed in properly equipped and modernly operated establishments. While the proprietor of the old fogy shop is congratulating himself that he can get men to work for him at wages lower than are paid elsewhere, it is no bargain that he is getting after all, for it is cheap men only that he catches and holds, the higher priced men being grabbed up by those who can appreciate them and who provide whatever will help them to productive activity. The man who pays the highest wages to the workman is not in that mere fact necessarily his best friend, it is rather in his providing the conditions which make the paying of such wages a profitable investment. In looking out perhaps entirely for himself he still is helping the workman in the most effective and practical way possible.

There is another fellow who, if he could know all about it, would have some ideas in this connection, and that is the competitor in precisely the same line of work. It happens that the machinery which the shop to which I refer is producing is also turned out in more than one well equipped shop by up-to-date methods. It would make the proprietors smile to see that flywheel in that lathe. They might do more than smile. They might be saying to themselves, "If those fellows can take from four to ten times as long to turn a flywheel as we do it in, and other work in proportion, there must be something wrong with us somewhere that we don't make more than we do," and then they will be looking around to see what the matter is.

TECUMSEH SWIFT.

Saving Time in Making Drawings.

Editor American Machinist:

So much of the work in the drawing room nowadays is based on some previous design or is to be like, with certain improvements, various parts of other machines, that on the whole a great deal of copying is done. Now if the scale can be kept the same (and much labor might be saved by keeping a standard scale for certain machines), one can trace a great many parts and, by penciling in the rest, a long job is made short.

Now about the great dislike that exists in regard to shifting tracings: I have seen many draftsmen lay down work that required four or five hours, in order that when they began to trace it they would not have to take up the tracing. That

FIG. 1. NEEDLE POINT.

very tracing could have been shifted in five minutes and thus at least four out of the five hours could have been saved.

I wish to show a few little things which are convenient and great time savers. They are not new, and perhaps are used by a great many, but there are many persons who do not use them. Fig. 1 shows a needle point which is made by cutting off the end of a wooden pen holder; the end is then beveled off and a hole put in the center. Now take a No. 5 needle and break it off about one inch from the pointed end, grind the broken end sharp and then hold it with a pair of pliers and drive it into the pen holder, letting the point project about 3/8 of an inch. As the penholder is tapered it cannot roll off the desk. You should make two of these pins and you will be surprised at the many times you will have occasion to use them. There is a certain firm who make all their drawings on a special extra heavy grade of paper, and ink them in for reference. It is a "criminal offence" to push a thumb tack into any part of those drawings; but these pins can be put through and through hundreds of times and no harm will be done.

The ragged rectangular figure shown in Fig. 2 is intended to represent a piece of tracing paper; it is very thin and easily torn. For this reason, take a piece of heavy paper about a foot or 18 inches square, and coat it all over on one side with mucilage; when dry, cut up into small pieces, about 1/2x3/4 inch, and when you are working on tracing paper, just stick one of these on each corner and place your pin right through into the board. You may have half a dozen or more tracings on your board, but you can pierce the points through all of them.

One other thing: So many drawings look so dirty that you can scarcely see the lines. The secret in keeping a drawing clean is not to wash your triangles with soap and water; just wipe them off with a rag, and, instead of sliding them over the paper, pick them up and carry them where you want them, or else slide them on the corner, so as to have a line, only, in contact with the paper. Never slide anything over your drawing; keep your elbows and the points of your fingers off the paper. Never put a pad on your drawing; just look at the pad, underneath it is always full of dirt. If you want to figure, put a piece of clean paper on the drawing and then put your pad on it.

FRANK B. KLEINHANS.

Home Made Tools.

Editor American Machinist:

For versatility your correspondent, Mr. Tecumseh Swift, fairly "licks creation."

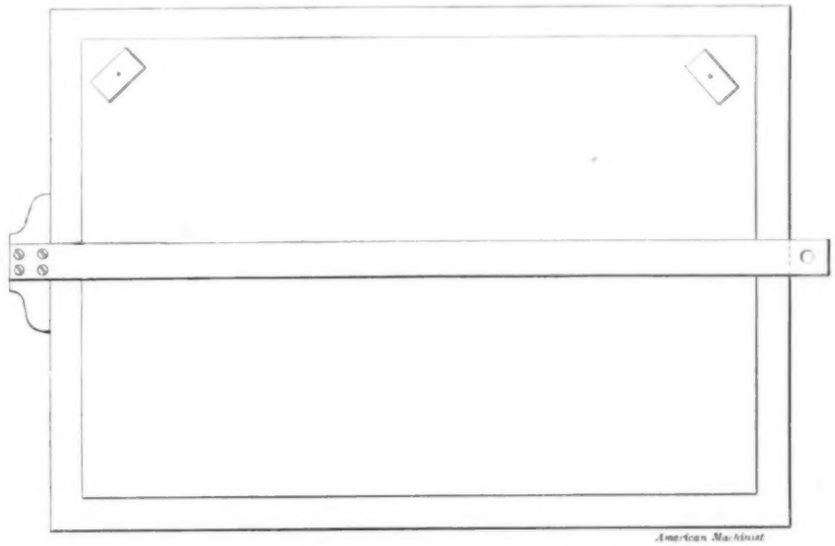


FIG. 2. HOLDING TRACING PAPER ON THE BOARD.

He has one good point, however: whatever he writes about always makes interesting reading. Especially interesting to me was his letter on "Home Made Tools" at page 1202.

Engineering workshops comprise concentrated collections of mechanical appliances worked for the purpose of making "hard cash." It is obvious that to get the best results it is necessary to keep the mechanical appliances in a high state of efficiency, and it was early found that the most economical results were obtained when a special department was kept for this purpose, hence the why and where-

fore of the repair shop. Anybody with any experience in the management of a repair shop knows, to his cost, that breakdowns usually come in batches. One week the shop may be kept going night and day, and the next week the men will probably have nothing to do. This "clock-watching business" does not, however, swell the dividends, and it is obvious that the department must have a stand-by job. This is probably the main cause for "home-made tools."

Tecumseh Swift says that the regular tool builder always knows what defects still lurk in his machines. How much more must a department that keeps these tools in repair know about their defects. I undertake to say that a good "breakdown" shop is, in some respects, specially qualified to build its own tools. James Watt would probably never have invented the modern steam engine if he had not had to repair a model of Newcomen's atmospheric engine and noted the defects therein.

I don't altogether agree with Tecumseh Swift in his argument on prices. The very fact of keeping the shop going in a slack time quite counterbalances anything extra in the cost. The reason why the costs are so much greater in a "home-made tool" is often through the good quality put in them. The general tool builder has to face keen competition and naturally cuts down his prices to a minimum. For example, I know a prominent American tool firm that fits its vertical boring mills with cast-iron feathers. I am sure no "home-made tool" would contain such "shoddy" work. I was once with a firm that gave £350 for a machine that is turned out by the dozen both in America and Europe. This firm, from the cause I have given above, decided to give its repair shop a chance in this line, and was agreeably surprised to find that the *actual* cost for a much better built machine was only £342. I could give several other cases of a like kind. When it comes to a special tool the "home-made builder" stands on an equal footing with the general builder, and, as far as my experience goes, can always give a good account of himself both in *actual* price and in workmanship.

I was glad to see your correspondent's fatherly advice to young draftsmen, and I quite agree with him in this respect. If half the teaching that is spent on steam engines was given on tools many a grand invention would not have needed to have been abandoned. Bishop's famous "rotary disk engine" is a case in point.

England. SARTOR RESARTUS.

[We cannot believe our correspondent's story about the cast-iron feathers. If they have ever been used, it must have been for some other reason than the cheapening of construction—to secure a better wearing material, for instance. No one would think of working up and fitting in a cast-iron feather for the sake of cheapness. It would almost certainly cost more than would steel.—Ed.]

Indexing Periodical Literature.

Editor American Machinist:

I have been very much impressed by "Constant Reader's" troubles in indexing matter for reference from mechanical papers or publications, and I feel as though I ought to come to his rescue by suggesting the following method which I have found to be satisfactory in a good many ways:

For a number of years I made it a practice to index that page of the AMERICAN MACHINIST, as well as other technical publications, containing an item of interest, in an ordinary letter file. This method, however, proved to be cumbersome and fell short of the mark, as the bulk of reference matter increased. It happens frequently that one of the above-mentioned pages contains several articles, and the difficulty of indexing becomes at once apparent. In other cases it may occur that a long article is spread over several pages, and this would necessitate fastening together. If it is desired, for instance, to refer to construction of dies, we would have to extricate all the articles under heading *D* and glance over the whole contents in order to find the desired information. Another grave objection to the letter file system is that all kinds of subjects are thrown together under the same heading and a lot of time is wasted in separating the different subjects. The most serious objection, however, is the mutilation of the journal itself. A bound volume of an up-to-date technical publication is an invaluable addition to any library. Few workingmen can afford to stock their meagre libraries with technical works that oftentimes do not bear sufficiently on things concerning their particular scope of activity. There are few, however, who could not afford to have their AMERICAN MACHINIST bound at the end of the year and thus obtain a book which could hardly be bought with twice the amount of money and which becomes almost indispensable to the shopman on account of its almost endless variety of subjects.

The method of indexing, which I have followed for some time past is simple enough. A pad of white paper with detachable cover serves as index. These pads, as well as covers, may be bought at most stationary stores. Two holes along the edge of the covers and pad allow fasteners, which are also for sale, to be inserted and in this manner give the whole the appearance of a book. In order to index interesting matter, we first give each subject one sheet of the pad and arrange the whole alphabetically. Between the various subjects a different sheet of paper is inserted bearing the title of the subject to follow. Taking, for instance, the last issue of the AMERICAN MACHINIST, we would make a short notice of the article "Sizing Blanks for Drawing" on the sheet bearing the title "Drawing Dies" in the following manner: "Sizing blanks for drawing, AM. MACH., Oct. 9, 1902. P. 1455." If any information on this subject is desired, we would only have to refer to this sheet and then turn to the issue mentioned without having the slightest difficulty of finding it. The article by Mr. Kleinhans, treating of the strength and proportion of keys, would be noted in the same manner on the sheet bearing the title "Keys," and so on. If a sheet should in the course of time be filled with references it is only necessary to insert a new sheet in the space touching on the particular subject. I have found this method of indexing very satisfactory, and take great pleasure in noting down items of interest as each issue makes its appearance.

FRANK GREINER.

Mechanical Schools.

Editor American Machinist:

Several articles have appeared in your columns recently on mechanical schools which were especially interesting to me because, as a graduate of one, I have been able to see some of their shortcomings. Mr. C. H. Norton, at page 980, has written on the subject, but, with the editor's consent, I will give another of their shortcomings from my own experience.

Strange as it may seem, when graduating as a draftsman I had yet to learn the use of a scale, and actually started and made a drawing of a 5-ton hoist by dividing all dimensions by 4 to get them down to a proper size, in my first actual working day at a Philadelphia machine works. Can any person imagine my predicament? There I was, well grounded in projections and intersections, algebra and geometry, and yet did not know that there was such an instrument as a scale! I am almost ashamed to acknowledge this, but it is only too true. My only consolation is that I spied a scale and solved its mystery and use before anyone discovered what I had been doing. This was the condition which at least fifteen graduates were in, as I afterward learned; but they all, I believe, grasped the situation without being discovered.

Some time afterward I visited the school and was asked "whether I found the gearing formulas handy," etc., and in reply I related my experience. My questioner was much surprised and embarrassed and assured me that the fault had been remedied—a much-needed remedy, I am sure.

Our manual training schools, year after year, persist in trying to make showy exhibits, which are sure to please the unthinking parent and serve to impress the boy with his greatness. These schools state that they are not intended to turn out mechanics, but why do they persist in having the senior students construct such complicated machines as gas engines, and dynamos? In an exhibition which I attended they actually had a 10 horse-power triple expansion engine which was

claimed to be the work of the senior class. These tactics do the schools a great injustice, and in fact all concerned, for any person well informed in such matters knows that young men from the ages of fourteen to seventeen are not capable of doing such work, which has a strong tendency to cause bad cases of cranial enlargement. S. P. Y.

Setting and Holding Cores—Drying Cores.

Editor American Machinist:

In complicated cored work the demands of the design make it necessary at times to use cores that rest upon one another, forming together a whole that, in all fairness to coremaker and molder, it would not be wise to attempt to make in any other way.

The customary method, that of having the matching end of one core resting on the bottom of a print pocket of another, as shown at Fig. 1, has been proven in many cases to be unreliable on account of the particles of sand dislodged from the sides and falling to the bottom while in the act of setting, thus preventing the faces from resting squarely as shown at *C C D D*.

A system that is in successful use by at least one concern that insists upon cored castings being tolerably correct, is through the medium of shouldered core prints, such as shown at Fig. 2, where, for the purpose of illustration, we will suppose that chambers formed by cores *A* and *B* are of such shape as to make it impracticable to ram up the cores in one box; so we decide to make it in two cores and connect the same by having a print or prints in core *B* to set core *A* by. We will assume that the connecting hole is round —say, 4 inches diameter—then we make the print in core *B* 2½ inches; that will insure us a fair shoulder for core *A* to be set with and rest in its proper place, care being taken to make the depth of the core-print pocket greater than the length of the matching core, as at *C* and *D*, so that the shoulder *H H* will touch. The same method is used to connect core *B* to the green sand, the spaces at *C* and *D* allowing space for the loose sand *E E*. In this connection it would be well to remember to make core print in core *B* with less taper than that of core *A*, the two being to size only at shoulder *H H*. The relative tapers of the prints are shown greatly exaggerated in Fig. 2.

In making steam engine pistons of hollow section, as at Fig. 3, or stereotypers' steam tables, as at Fig. 4, or, in fact, any of that class of work, the shouldered core print and core present very near the ideal means to a successful end, as but three core-support holes will be necessary—except in extreme cases—to act in the triple capacity of core setting, venting and cleaning, the shoulders at *A A* and *B B*, Figs. 3 and 4, insuring proper thickness of metal, the small step above the shoulder being made long enough to project clean through the cope, making the same large enough in diameter to give room for vent holes, and core rods threaded on the upper ends as shown. The core rods are in some cases made of pipe, also threaded on the upper end and perforated below, to be used as vent tubes and core arbors in one.

The benefits derived by using this method in making castings are manifest to any student of the game, not the least of which is the decided advantage of being able to secure the core permanently in the cope before closing.

At Fig. 5 is shown another way of using the shoulder. In this case the core is laid and set horizontally and the only opening into the chamber being small, it is necessary to make a core print of sufficient volume to balance matters, and incidentally to give the end-set accurately by means of shoulder *A A*, which provides against the fondness the molder has for scooping out the end of the core print space, a practice resorted to by reason of the carelessness of patternmakers in making the over-all length of core boxes the same as, or greater than the over-all length of, the pattern, a cause of more "crushes" than ever happened at the entrance to the Brooklyn Bridge. While on this crushing subject let me call the reader's attention to Fig. 6 at *A A* and Fig. 2 at *F F F F*, where a fillet is shown which, if placed on all patterns, will save the molder the trouble of chamfering his mold at this point, something he otherwise certainly will do to prevent a "crush." This fillet can be of any shape, and it would seem to be good policy for any firm wishing to reduce foundry costs and to increase their output, to adopt this little kink, as the first cost is trifling. On patterns already in use a leather fillet can be applied to all such corners by any handy man.

The common practice of making prints to shrink rule and core boxes to common rule to allow for core expansion is incorrect in most instances, and the nearer they are made to match the better they will be every time, for the rapping the molder subjects the pattern to is ample in most cases to provide for the expansive influence of flour in the cores.

It might surprise some of the experts to know that a very successful concern manufacturing plumbers' supplies makes it a practice on all its light brass work of having all core prints made *smaller* than the core box when cores are to lie in a horizontal position. In machine molding, core print and core box must be of equal size when a vibrator of short stroke operated by compressed air is used, for, singular as it may appear, the mold is not enlarged by its action to any appreciable extent, as an attempt to place the pattern back in the mold will prove conclusively.

To retain the shape of a core true to core box while being baked is a problem that has puzzled more than one foundryman, and, where cores are made in quantity for standard work, it becomes a question of economy as well to dry cores quickly without distortion.

Through the medium of "driers," all cores, however designed, can be cooked to a turn without destroying their accuracy if bound at the setting points, partly enclosed, or entirely so, in cast-iron boxes or driers such as shown at Fig. 7, where

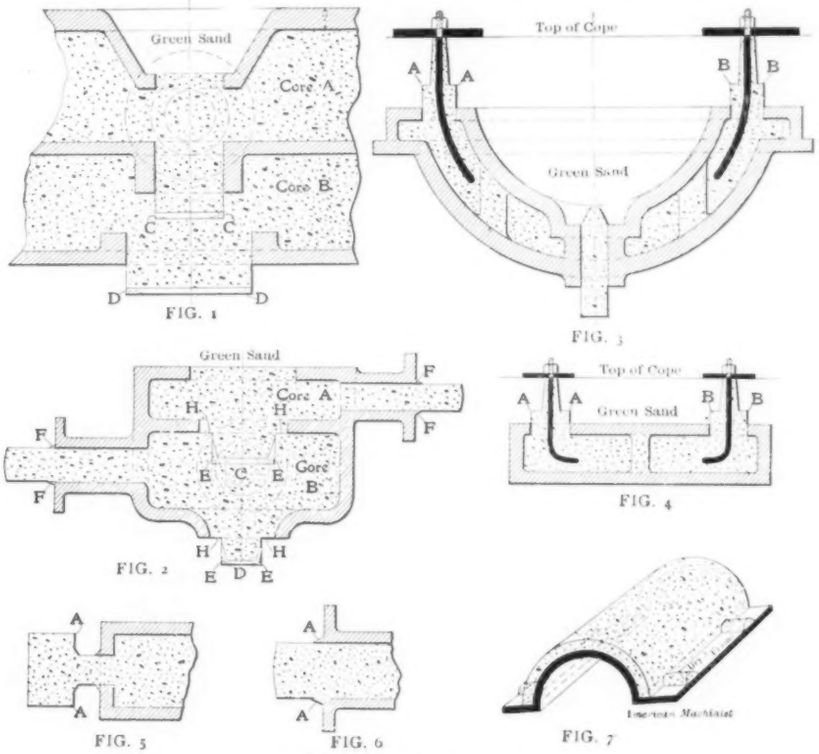


FIG. 1. FIG. 3. FIG. 2. FIG. 4. FIG. 5. FIG. 6. FIG. 7.

SETTING AND HOLDING CORES.

a jacket core is seen to rest on a drier frame of cast iron that had previously been placed in the wood core box—where a strickle had been used—then turned over and the core box drawn away, leaving the half-core in shape to be placed in the core oven unencumbered by the usual backing of green or white sand that prevents at least one side of the core being dried while the other is burned to a crisp, something that happens frequently, even when cores are of an equal section and "driers" are not used. OLD BOB.

What John Fritz Did.

Editor American Machinist:

The remarkable ovation given by the members of the four engineering societies to Mr. Fritz was a tribute not to the inventor but to the man, not to what they admire but to him whom they love. Not his works, but himself; not his genius, but his character, was the high theme by which that great assembly was inspired. The verses of Mr. Raymond [reproduced in this issue—Ed.] give fitting expression to the common feeling of affection. Who can measure the beneficent and widespread influence of such a life, a life that could inspire such a universal emotion? His works were scarcely alluded to. It was no time to descend to a cold enumeration of his varied achievements.

As I have reflected on this most interesting event, by way of contrast with its elevated tone the following incident has been brought forcibly to my mind.

Some three or four years ago, one Sunday afternoon, I received a call from Mr. Henry C. Meyer, of the *Engineering Record*, who is a fellow townsman of mine in Montclair. He told me that Mr. Rockefeller had been building a fleet of twenty-one steamers for the transportation of ore on the lakes; that he had formed a plan to name these vessels after the great leaders in metallurgical and engineering science and art, and had committed the selection of these names to his confidential agent, Mr. F. T. Gates, who is also a resident of Montclair. Mr. Meyer told me further that twenty of these vessels had already been launched and named, and the last one was approaching completion; that a few of the admirers of Mr. Fritz, who knew of this proceeding, were anxious that this one should bear his name, and a committee of their number had waited on Mr. Gates and urged upon him this selection. He added that for some reason which they could not divine Mr. Gates had hesitated about the matter, the gentlemen being obliged to leave without receiving any positive assurance on the subject, and that it had occurred to him that I might be able to say something to Mr. Gates that would incline him favorably, and he wanted me to see him for this purpose.

I replied that I was a stranger to Mr. Gates, and, moreover, did not imagine that I could add anything to what had probably been said already. He urged, however, that he would like to have me go any way, and see what might come of it, and said if I would go directly he would go along and introduce me; so we went. Mr. Gates was not at home, but would be later; so at Mr. Meyer's request I called again alone, introduced myself and told the purpose for which I had been requested to see him.

I found that Mr. Gates' view was of a very definite and practical character. He told me that their purpose was to honor the men who had done the most to promote the use of iron and steel in the world; that he had been greatly interested and impressed by what the gentlemen had told him respecting the important part borne by Mr. Fritz in the development of the iron and steel industries in this country, and was very anxious to meet their wishes and name the boat for him, but this difficulty seemed to be in the way: Each one of the men whose names had been selected had done some *one* particular thing of importance in increasing the consumption of iron and steel, and these gentlemen had failed to point out any one particular thing that Mr. Fritz had done, and that had made him hesitate, but he would be very glad if this difficulty could be removed.

I replied that I was surprised to hear his statement, and that I felt sure that his very proper requirement could be fully complied with. I then told him that Mr. Fritz was the inventor of the three-high train of rolls, which had revolutionized the rolling-mill business, being now used universally, except for rolling armor plate, where the train was stopped and reversed at the end of every pass. As he had no knowledge on the subject, I was obliged to explain to him that previous to this invention iron and steel were rolled between two rolls, and after every pass the bar was returned idly on the top roll to pass through again, and that the use of the train was quite limited, because thin sections cooled and cracked along the edges, and at each successive pass these cracks opened wider, and the bar would be ruined. I told him that in the three-high train the bar was reduced on the backward pass also, doubling the production of the train; that its heat was kept up to the end of the operation, heat being added mechanically as fast as it was lost by radiation; and, most important of all, the passes being alternately in reverse directions, cracks opening on one pass were welded up on the next one, so that any sections whatever could be rolled with the certainty of sound edges, thus enlarging the usefulness of the train indefinitely.

I told him that not only did Mr. Fritz make this invention, but that by his force of character and indomitable will he compelled its trial against opposition that would have crushed any ordinary man. All experts who would commit themselves gave an adverse opinion. Every one in the business denounced it as the hight of folly. His friends implored him not to wreck his prospects in life by insisting on a chimerical scheme that was sure to fail. And finally the directors of the Cambria Iron Company passed a resolution ordering him, then their superintendent, to build the proposed train in accordance with the established usage. This last Mr. Fritz met by promptly sending in his resignation. This brought them to their senses, and they finally permitted him to try his experiment.

"Why," exclaimed Mr. Gates when I had finished, "this is precisely what I want. But why was I not told this at first?" I replied that I could not answer that question; it puzzled me as much as it did him, but he might rely on the correctness of my statement. This he evidently did, for the next morning we chanced to meet on the way to New York, and Mr. Gates hailed me from a little distance and said, "I have named the boat 'John Fritz.'"

I remember when I was a boy hearing about some great debate in the United States Senate between the giants that were in those days, in the course of which Senator Thomas H. Benton of Missouri uttered this expression, "Solitary and alone I set this ball in motion." This tautology, from its force and its euphony, struck the popular fancy, and the expression became famous. I have often thought respecting Mr. Fritz that "solitary and alone" he did not set any ball in motion merely, but he began and ended, he commenced and completed, this invention the value of which is incalculable, for it made possible the production of almost all the shapes of steel now so extensively employed.

I know of only one modification of the three-high train as it left the hands of its inventor. This is the elegant design of Mr. Wellman for the great plate train of the Otis works, in which enormous blocks of open-hearth steel are rolled into plates 12 feet wide and 20 or more feet long. In this train the middle roll is comparatively small in diameter and is rotated rapidly, but it could not endure the stress of the work. It is reinforced through its entire length by the top and and bottom rolls. These are very large, and at every pass the middle roll rises or falls to come in contact with one or the other of them. Other modifications may exist with which I am unacquainted.

The development of the rolling mill which has been made possible by Mr. Fritz's invention is well illustrated in the present rail mill, in which the steel ingots are rolled at once into rails nearly 200 feet long, to be afterwards sawn into 30-foot or 60-foot lengths. As I have seen these ingots reduced without being touched by a human hand, running at great velocity up in curved troughs in front and back of the train and guided in their descent into the next grooves or the next

rolls, I have been reminded of a question I many years ago heard asked by Mr. Erastus Corning, and its answer. I was standing with Mr. Corning, watching a rail train, when he inquired of a boy why the blooms could not be run through the train more rapidly. The boy replied: "Because the gentlemen at the hooks couldn't catch them, sir." Where now are "the gentlemen at the hooks"?

I thought a good deal about this incident of naming the boat, and found myself face to face with a phenomenon that I could not account for. Here were a number of engineers (I never learned how many or who they were), admirers of Mr. Fritz, and prominent in the effort to procure for him this distinction, and who yet were evidently unacquainted with the fact of this invention which constituted his supreme title to this distinction. This seemed to me unaccountable, until I recalled the fact that I myself, in the course of a number of years during which I was in close touch with rolling mills, never once heard Mr. Fritz mentioned as the inventor of the three-high train. I tried in vain to call to mind a single occasion when I had heard of this connection, and finally became convinced that I never had heard it spoken of during that time. I should have been entirely unable to supply this information to Mr. Gates, had I not recalled a conversation that I had about twenty years before with Mr. James Moore, of Philadelphia, the eminent builder of rolling-mill machinery, in the course of which Mr. Moore, with much enthusiasm, had told me the whole story. This remained fixed in my memory, and served me well on this occasion.

The explanation of the matter seems to be this: The three-high train on its first appearance was immediately seen to be indispensable. All concerns who expected to continue in the rolling-mill business must adopt it; consequently, it sprang rapidly into general use. It soon ceased to be a wonder and became a familiar every-day affair. It did not need to bear the name of the inventor to distinguish it from any other system. There was no other system. The subject of its origin soon ceased to be talked about. Engineers coming year after year into rolling mills saw nothing else, heard of nothing else. The three-high train was always before them, the essential feature of *a* rolling mill, and they naturally supposed it always had been, or rather gave no thought at all to the subject.

And so, in the most natural manner, the origin of the three-high train came never to be thought of; and we had this wonderful phenomenon, absolutely, I believe, without precedent or example in the whole history of inventors, of the personality of an inventor being hidden—completely hidden—absolutely lost to sight in the transcendent glory of his own invention.

CHAS. T. PORTER.

Punching Brass Clock Gears—Working Aluminum.

Editor American Machinist:

I have read Mr. Doran's description at page 1544 of a die for pressing out clock gears, or wheels, as they are generally called among clockmakers. The concern with whom I am employed presses out hundreds of thousands of these wheels every year, and I cannot see how Mr. Doran kept his wheels flat by a spring stripper only on the punches; also how the tooth part of his die was kept perfectly round or a true circle on the teeth when hardened. Clock wheels of this description can, as far as I am able to ascertain, be pressed out of metal all parts true with one another only in one way, namely, in a sub-press and all operations performed at the same time, piercing, cutting and blanking, with spring strippers on both sides of the metal to keep it flat, and the wheel pressed back into the stock or strip from which it was punched. I suppose Mr. Doran might have made wheels good enough for the work in which they were used, but I would not give much for a clock wheel made by his method. The tooth part of his wheel would give better satisfaction if it was made of a ring inserted into the die block, as it could have been brought to a true circle in tempering if it should spring in hardening.

Mr. Danse asks for information regarding the working of aluminum. We tried to use it in sheet metal about .050 thick, a number of small holes to be pierced in it. We found the punchings so light that they loaded in the dies and broke the punches badly. In drilling and reaming we used kerosene. The punches and dies were worn out about twenty times as fast as brass would wear them, and after working up about 20,000 parts went back to brass. It seems to have a gritty nature and is hard on tools in punching.

I enclose you the last wheel on a 60,000 run without sharpening punches or die.

THOS. W. R. MCCABE.

Winsted, Conn.

Instructions for Foremen.

Editor American Machinist:

In many shops are to be found, posted in conspicuous places but covered with dust and dirt so that reading them is out of the question, notices entitled "Rules for Employees." Even if clean, the rules are seldom read, and in many instances are never enforced.

While visiting the works of a large concern in the East, whose force numbers over 1,800 men, I noticed the absence of all such signs or notices, and upon inquiry I found that upon the appointment of a foreman he was furnished with a slip of bristol board folded so that it could be carried in a vest pocket and on which was printed the following:

INSTRUCTIONS FOR FOREMEN.

1. Be punctual; during business hours attend strictly to business, and require the same from those under your charge.

2. Foremen in the employ of this firm must not keep nor own any interest in any saloon, boarding house or lodging house.

3. Allow a reasonable time for cleaning up once a week, or when necessary, and see that it is properly done.

4. Unnecessary talking, singing or whistling must not be allowed.

5. See that all machinery is oiled, kept clean, belts laced and in good order.

6. Report at the office at once any matter considered dangerous and all accidents.

7. Participants of quarrels must be discharged.

8. All tools taken from the toolroom must be returned soon as possible after using, and shall be wiped off or cleaned when returned.

9. Allow neither time nor material to be wasted.

10. Give full instructions in all cases and observe that they are complied with.

11. Do not be above receiving suggestions if practicable.

12. All orders must be filled with accuracy and dispatch, and in regular order unless directed otherwise. They must also be signed with the initials of those giving the same.

13. Have a place for everything, and see that it is kept there.

14. Smoking is not allowed, neither must employees carry matches in their clothing, unless in match-safes. Those who chew tobacco must provide a cuspidor, which can be purchased at the storeroom for 10 cents, and it must be cleaned twice a week.

15. Food and clothing must be kept in lockers and dinners and lunches eaten in the dining room.

16. Treat all alike; don't jump on a man for a trifle. Treat men with kindness, but firmness should be observed at all times.

Thus the foreman was held directly responsible for a strict observance of all regulations by those under his charge. While reading about the carrying of matches I smiled; but when it was explained to me that this firm has been burnt out three times, and I stopped to think how easily one could drop a match from a vest or pants pocket in the dark after the whistle had blown and the lights were out, the wisdom of such a rule can be readily understood. For both employer and employee it is—no factory, no work.

In regard to spitting tobacco juice all over a place, the rule is a very sanitary one.

The last one—treat all alike—alas! there are many shops where that needs to be applied. One I had an experience in where the foreman would spend two hours "chinning" with a lathe hand with his machine stopped and then go over and "jump on" another who ran two lathes because he happened to be looking out of the window.

C. NEIL.

AMERICAN MACHINIST

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The Great Invention of John Fritz.

It is at once an honor and a pleasure to us to be the means of giving to the engineering world the noble tribute of one venerable engineer of world-wide and richly-earned repute to another. The letter of Mr. Charles T. Porter, upon another page of this issue, is no perfunctory expression of kindness and good wishes made to fit a unique birthday occasion. While begotten of good will it is still a word most necessary to the appreciation of the thing that John Fritz did and which none was in a better position to say, which none could have said better than the writer. The enduring renown of John Fritz may be based upon his work as a whole, but, as with other great engineers, there is at least one specific thing that belongs to him and with which his name should evermore be associated. He invented the three-high mill, had to fight for its adoption, developed and applied it to complete success and made it thereafter a necessary component of every steel mill in the world. Mr. Porter tells us, so that we have no need to rehearse it, what a revolutionary and epoch-making invention it was. Remember John Fritz always as the man who worked himself from the very bottom to the very top of the supreme industry of modern civilization, but never forget that on his way up he invented the three-high mill.

The Advertisers and the Advertisements of the American Machinist.

In our voluminous anniversary issue, which immediately preceded this, some important topics failed to receive their share of attention, and one of the most important was ignored or forgotten entirely. We certainly should have spoken of our advertising pages. The two departments of the paper have traveled along side by side all these years with wonderful smoothness and with comparatively uneventful prosperity. They have been always mutually helpful and have both worked constantly for the uplifting and quickening of the workers and the stimulating of the activities of the trade. Each department has always rejoiced with no tinge of jealousy in the prosperity of the other, for neither has been able to appropriate to itself all the fruits of its own prosperity. The reading pages have nothing but words of congratulation that the advertising pages now outnumber them in a greater ratio than they once held over the other, and certainly the readers should rejoice most of all, for they are the ones ultimately most benefitted by the growth of both departments. If our reading columns are valued at all they certainly are more valuable, because more costly, than they could possibly be without the aid of the advertising part, for a large portion of the income derived from the advertising department is poured constantly out to support and add to the value and attractiveness of the reading part of the paper. Without the advertising pages well supported the reading pages of the paper would be much less worth the support of its constituents. The regular subscribers to the prosperous periodicals of the day—of which this is one—are always sure of their bargain, for they are always getting more than their money's worth, or more than their unaided money could possibly secure. The subscribers, therefore, are the ones above all others to rejoice at the numbers of advertisers and at the magnitude of the individual advertisements, for in them there is always more or less of pecuniary value that will come back to the reader.

This is not in the least putting the advertising department in the position of a necessary evil to, or a nuisance to be tolerated by, the subscriber and reader. The reader of the paper who is not a regular reader of the advertisements does not get as much for his investment of time and money as he could and should get. He does not learn as much as he should learn and could learn of the things that would help him in his business. The advertisements, although usually put out by the seller are equally in the interest of the buyer, buying and selling being a reciprocally desirable and beneficial transaction. Many for their own good need to be urged and almost compelled to buy the new facilities of the trade, even after they are fully convinced of their value. Our reading columns would largely fail in their mission of diffusing information as to new tools and new facilities of various kinds if their mention, with illustration and description, was not followed up by the soliciting and reiterating advertisement. The advertisements are made attractive and readable by a vast amount of labor and painstaking, and the doers of this work are really employed in the interest of the readers of the paper, and it is the business of the reader to get the good of that work as of all the good work that is done for him, and this he cannot do if he does not know what the advertising pages contain. The reader who has ever the passing wish that he might handle the reading pages alone and never be compelled to handle or see the advertisements is, we are convinced, not entirely appreciative of the interdependence of the two departments or of the benefits that they both have to offer him. We are happy to believe, with the full interests of all our readers uppermost in our minds, that the advertising pages are destined to continue to grow, so that their presence is something to be accepted, whatever the peculiar views of the reader may be.

While some readers may be thus somewhat unappreciative of the value to them of the advertising pages of the paper, their position is not altogether to be wondered at when we note the attitude of some advertisers. These, too, are not altogether to blame, for many of them have been badly brought up, or have been mis-

educated as to their rights and privileges, and their expectations have been stimulated into abnormal development. They have been so urged and solicited as to have acquired somewhat exaggerated ideas of what their money should buy. Of course advertisers pay large sums for their advertising, but he must be a peculiar man who pays it except for a full equivalent, the same as in buying steel or coal; and, receiving his equivalent, it is not evident that he is any more a *patron* of the paper which prints his advertiseents than of the companies which supply his materials.

It has been the constant determination of the editorial department to make the paper of the greatest possible value to those who were to become its habitual readers, and to attract to its reading columns those most interested and active in the shops. This, as we take it, has been the conferring of the highest possible good upon the advertiser, and for our persistency in this endeavor we are entitled to his appreciation.

It has been to the mutual advantage of the two departments of the paper, as it has been also to the advantage of both the reader and the advertiser, that the editorial department has, above everything else, insisted upon and maintained its independence. Its hands have not been tied, and its time and energies have been devoted to the setting forth of mechanical news without bias, and its faithful adherence to its legitimate business has been the maker and upholder of its value as an advertising medium.

The simple fact is that both the reading pages and the advertising pages are for the reader, and it is to his interest, whatever may be his individual views, that both be maintained and advanced to higher efficiency. Both departments belong also to the advertiser. It is especially to his interest that the reading pages should be always filled not only with attractive matter, but that whatever is said shall be what it appears and claims to be. This it could never be if anything ever appeared by the dictation or purchase of any interested party or in consideration of any actual or assumed "patronage." It is a great pleasure, therefore, to assure both reader and advertiser of our patient and untiring continuance in the work which has so far been so successful, and we solicit and expect their continued cooperation for mutual advantage.

Mistakes have been made, of course, and we do not hope to avoid them in the future, but the one fatal mistake for a journal to make we shall not make—*i. e.*, we shall not print as reading matter stuff known to be valueless because some interested party wishes us to do so. Our mistakes will be at least honest ones, and we desire to be honest with ourselves as well as with our readers.

Meeting of the Naval Architects and Marine Engineers.

The following is a list of the papers to be presented at the tenth annual meeting of the Society of Naval Architects and Marine Engineers to be held at 12 West Thirty-first street, November 20 and 21:

THURSDAY, NOVEMBER 20.

1. "Technical Training for Shipbuilders." By Henry S. Pritchett, LL.D.

2. "Progressive Trials of the Screw Ferryboat Edgewater." By Edwin A. Stevens, vice-president, and Charles P. Paulding, Junior.

3. "Why It Takes So Long to Build and Equip a Naval Vessel for the United States." By George W. Dickie, member of council.

4. "The Preliminary Official Trial of the U. S. Battleship Maine." By Assistant Naval Constructor J. W. Powell, U. S. N., associate.

5. "The Water-Tube Boiler in the American Mercantile Marine." By William A. Fairburn, member.

6. "Longitudinal Bending Stress on Damaged Ships." By George C. Cook, member.

7. "Some Problems on the Surfaces of Buoyancy and of Waterlines." By Professor Cecil H. Peabody, member of council.

8. "Experiments and Formulas on the Strength of Ships' Beams." By K. G. Meldahl, naval architect, Germany.

FRIDAY, NOVEMBER 21.

9. "Vibration of Steamships; with Special Reference to Those of the Second and Higher Periods." By Rear Admiral Geo. W. Melville, Engineer-in-Chief U. S. Navy, vice-president.

10. "The Development of Modern Ordnance and Armor in the United States." By Rear Admiral Charles O'Neil, Chief of the Bureau of Ordnance, U. S. Navy.

11. "Remarks on the New Designs for Naval Vessels." By Rear Admiral Francis T. Bowles, Chief Constructor U. S. Navy, vice-president.

12. "The Tactics of the Gun." By Lieut.-Commander Albert P. Niblack, U. S. Navy, associate.

13. "The Possible and Probable Future Developments in the Use of Electricity on Board Ships." By F. O. Blackwell, Esq.

14. Submarine Boats; Their Present Development and Future Possibilties in Naval Warfare." By Lawrence Y. Spear, member.

15. "Measurement Rules for Yachts; with Special Reference to Racing Conditions." By F. W. Belknap, Esq.

16. Prize Competition Paper.

John Fritz.*

Whom shall we choose, the flag to hold
In our vast conquest, yet untold,
Which to the New World adds the old?
Donner and Blitz!
John Fritz.

Leaders unseen are with us met;
Nor they nor we the past forget.
The fate that took them early, yet,
Thank God, omits
John Fritz.

Who stands before us, to combine
A level head, an upright spine,
With nowhere any crooked line?
Most clearly, it's
John Fritz.

Whose heart is warmer than his blast?
Whose faith more steadfast to the last
Than any steel he ever cast?
That figure fits
John Fritz.

Whose fame commands our homage, such
As bears of envy not a touch,
Because we love the man so much?
Why, there he sits—
John Fritz.

On worthy breasts henceforward let
This token in his name be set—
A kingly name as ever yet
Signed royal writs—
John Fritz.

*By Rossiter W. Raymond. On the Menu of the John Fritz Banquet.

Some New Things.

A NEW GAS ENGINE IGNITER.

The Detroit Motor Works, of Detroit, Mich., have brought out an electric igniter for gas or gasoline engines which is being placed on the market as a distinct article of manufacture suitable for application to any make of engine. The igniter is of the induction-coil class, and hence has no moving parts within the cylinder of the engine. A handle is attached to the interrupter of the battery circuit by which the point of ignition may be timed to suit the condition of starting or the speed of the engine.

BLUEPRINTING MACHINE.

The Eugene Dietzgen Company, of 119 West Twenty-third street, New York, has brought out a cylindrical blueprinting machine employing an electric light which is lowered through a glass cylinder about which the tracing and blueprint paper are wrapped. The lowering of the lamp is by an electric motor, the action being reversed at the end of the downward movement, when the lamp is automatically and quickly returned to its elevated position. The machine is self-contained, and the cylinder swings on trunnions to a horizontal position for loading.

A NEW LINE OF ELECTRIC MOTORS.

The Akron Electrical Manufacturing Company, of Akron, Ohio, have brought out a new line of electric motors. Among the special features are a construction of the bearings whereby the motor may be located on the floor, wall or ceiling without change in the bearing sleeves or oiling mechanism and a construction of the brush holders which permits their removal without disturbing any other portion of the machine, as well as individual adjustment of the brushes. The brush holders are provided with a stop which prevents contact

of the metal parts of the holder with the commutator surface. The covers in the inclosed and semi-enclosed machines are of spun sheet metal, the thinness of which facilitates the dispersion of the heat.

NEW COUNTERSHAFT.

The illustrations show a new countershaft intended for driving tool grinders or other machines where the drive is al-

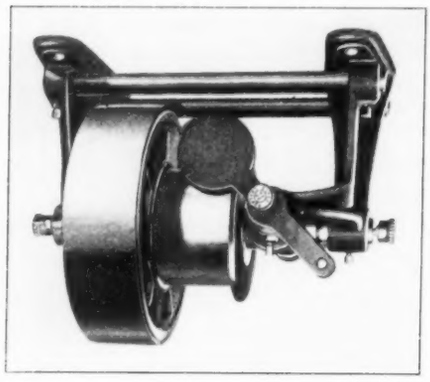


FIG. 1. NEW COUNTERSHAFT.

ways in one direction. This countershaft which, it will be noticed, is simple in construction and very compact, is started and stopped by pulling a cord attached to the end of the lever shown at the front in Fig. 1. In Fig. 2 a sectional view is given and the construction is here very clearly shown. The shaft itself—unlike most countershafts—does not turn, but is instead held fast by the set-screws shown in the hangers. The pulleys are mounted to run freely on the shaft; they have long bearings and, as the shaft is drilled out from each end and provided with grease cups, ample lubrication is assured. The friction disk is cast integral with the small or driving pulley and at the other end of this pulley a long spool is formed. Between the flanges of this spool, and arranged to run freely on the eccentric end

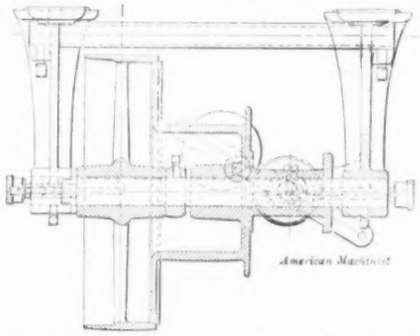
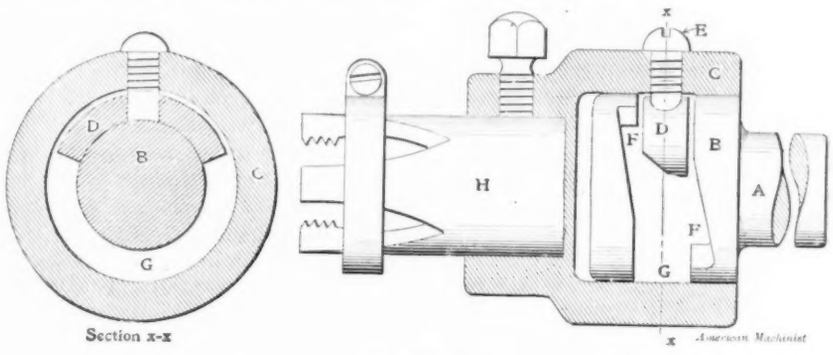


FIG. 2. SECTIONAL VIEW OF COUNTERSHAFT.

of a stud which is carried in a bearing formed in an arm of the right-hand hanger is a roll or disk. The same stud that carries this disk has on its outer end the weighted lever by means of which the friction is operated. The cord being pulled, the lever is thrown over and the roller or disk on the end of the stud being eccentrically mounted, forces the friction into the seat in the large pulley, the weight on the lever then being sufficient to hold the friction in place. When the cord is again pulled the lever is swung the other way and the roller striking the flange at the back of the spool the friction is released. When the friction is disengaged this roller does not run. In order that it shall always be properly oiled, the stud on which it is mounted is, like the countershaft itself, drilled out, from the end and fitted with a grease cup. The hanger which carries the weighted lever and the roller is so designed that these parts may be placed either in front or back of the pulley as may be required to clear the belt from the main line. The hangers are tied together by two pieces of pipe, as shown. As the pipes are clamped in place by set-screws, any end adjustment necessary when putting up the countershaft may be easily made. This countershaft is made with either a single driving pulley, as illustrated, or with a regular stepped cone. Hill, Clarke & Co., of Chicago, Ill., are the makers.

TAP AND DIE HOLDER.

The cut shows a die-holder, for hand or automatic screw machines, which has



DIE HOLDER.

recently been patented by F. C. Tyler, of 213 Beechwood street, Cleveland, O. In this holder the shank is solid and formed with a head *B* on which fits a socket or sleeve *C* that carries the die. A groove is cut in the head, as shown at *G*, and in this groove is placed a dog *D*, which is drilled to receive the end of a screw tapped through the sleeve which holds the die. The groove around the head, it will be seen, is milled at the sides at *F F*, and two shoulders are thus formed. In operation, when the die or tap touches the piece to be threaded, the sleeve *C* is pushed back over the head *B* and at the same time revolves forward until dog *D* passes into the notch and locks against shoulder *F*, where it is firmly held as long as there is any forward motion of the turret. When the turret has traveled forward as far as possible the sleeve *C* is pulled ahead until dog *D* is released, and it then revolves free until the spindle is reversed and the turret starts back; the dog then engages the other notch. When running idle and without any feeding motion, the dog acts as a saddle and will center itself in slot *G* and revolve freely in either direction without locking, but a very slight pressure will lock it at once.

Technical Publications.

"Heating and Ventilating Buildings." By R. C. Carpenter. Fourth revised and enlarged edition. 562 6x9-inch pages, with 277 illustrations and numerous tables. John Wiley & Sons, New York. Price, $4.00.

The present edition of this well-known book is about one-third larger than the original edition, and much of it has been rewritten. It is of very comprehensive scope and includes about all known systems of heating. It is strictly practical, and while mildly mathematical in spots, the conclusions of such work are usually given in the form of simple practical rules. The author is a well-known expert in this branch of engineering and his book has corresponding value.

"An Industrial Problem." By W. S. Rogers. 32 5¼x6½-inch pages, with 12 illustrations. Rogers Universal Cost System, Keene, N. H. Price, 10 cents. This book is primarily a description of Mr. Rogers' cost-accounting system, of which the special feature is the use of a dating clock to stamp the time when work on the pieces is begun and finished, while the merit claimed for the system is the promptness with which results are obtained by it. The booklet shows the forms and racks used and the method of operating the system.

"A Manual of Wood Turning." By C. R. Richards. 20 11x12½-inch pages, with 64 illustrations. The University Book Store, Lincoln, Neb.

This portfolio of sheets gives the progressive series of exercises in wood turning which are followed in the shops of the University of Nebraska. The exercises are well selected and are accompanied with instructions regarding the order in which the operations are to be performed and the methods of holding the work and manipulating the tools. In some cases these instructions are accompanied with illustrations of the methods of chucking the work and of supporting and holding the tools.

"The Naval Architects' and Shipbuilders' Pocket Book of Formulas, Rules and Tables." By Clement Macrow. Eighth Edition. 750 4x6½-inch pages. D. Van Nostrand Company, New York; Crosby Lockwood & Son, London. Price, $5.

It is, of course, impossible to review a pocket book. The only real test of such a book is use and of no class of books, perhaps, is a continued demand a better index of merit. The present edition represents extensive revision, among the additions being the most recent methods for determining stability, speed, etc. A feature wherein the arrangement differs from that customary in pocket books lies in the mathematical tables which are grouped together at the end.

Personal.

Frederick A. Hannah has closed his New York office and has become superintendent of the Crosby Steam Gage & Valve Company, of Boston.

J. D. Flack, M. E., engineer for the International Lithoid Company, has resigned that position to become erecting engineer and superintendent with the A. D. Granger Company, contracting engineers, 95-97 Liberty street, New York.

J. W. Duntley, president of the Chicago Pneumatic Tool Company, sailed for Europe November 4. He expects to remain about a month, and in England or Scotland he expects to establish a new plant for the manufacture of pneumatic tools similar to that at Detroit. This has become necessary in consequence of the rapid increase in the European business of the company.

Obituary.

Peter Brotherhood, who died in London October 13, sixty-four years old, had by his inventive talent and business ability contributed much to the advancement of engineering in Great Britain and throughout the world. We abstract a brief sketch of his life from an obituary notice in *Engineering*, of London. Mr. Brotherhood was the son of Rowland Brotherhood, a successful railway contractor, and received first a good elementary education and then took an engineering course, entering his father's office at nineteen for a short time and also spending a year in the locomotive works of the Great Western Railway. He spent several years in the drawing office of Maudsley, Sons & Field, and at the age of twenty-nine he began business for himself, first with a partner who was succeeded by another until 1878, when he was left alone in the business but with an excellent manager to assist him. In 1872 Mr. Brotherhood introduced his special three-cylinder engine, which has carried his name all over the world. This engine proved to be specially adaptable to the driving of torpedoes and generally superseded all others for that purpose, and this application of the engine turned Mr. Brotherhood's attention to the other special requirements of torpedo service. The engine also was employed in electric service, the first direct-driven dynamo being coupled to one of them. It was also generally employed for centrifugal pumps and forced-draft fans. The rapid development of this engine business led to the erection of extensive works in 1881, still regarded as an example in modern shop building. "The guiding principle of the design was the production of a factory in which all the local circumstances should aid in the rapid production of the best class of work, and in which every part should be thoroughly adapted to the processes to be carried on in it, and be open to constant and easy supervision. The works were considerably enlarged in 1896. Mr. Brotherhood designed the four-stage high-pressure air compressor generally used for charging torpedos, and the novel principles developed in it were employed also in other compressors and in pumps of his design. He contributed to the development of the modern high-speed engine for electric service. Mr. Brotherhood had the mechanical instinct unusually alert, so that he arrived intuitively at desired results which many others could only deduce from elaborate experiments or voluminous computations. He insisted always upon first-rate material and first-rate workmanship, but beyond these he gave up the direction of the commercial details to his manager. For some time previous to his death his health had been impaired.

An examination will be held on December 9-10 for the position of assistant (piece work computer) in the Nautical Almanac Office. The examinations may be taken in either of several places in each State. Full particulars may be obtained by addressing the United States Civil Service Commission, Washington, D. C.

Commercial Review.

NEW YORK, November 10, 1902.

We are informed by several machinery houses, who do a representative trade, that collections recently have taken an unsatisfactory form. For this condition of affairs, a variety of explanations are offered. The principal one is the money stringency which recently occurred in Wall Street, and which assumed such a serious aspect that the good offices of the Secretary of the Treasury were deemed necessary to tide financial interests over their difficulties. Another reason given is the immense amount of money which had to be provided to transport the crops, and which, by the way, is gradually finding its way back to the channels from which it was taken.

On all sides it is stated that the working assets of many industrial establishments have been affected as a result. Only a short time ago we noted that the American Bicycle Company was forced to go into the hands of a receiver, because, among other things, its working assets had become greatly depleted.

Now comes the announcement that the directors of the Wm. Cramp & Sons' Ship & Engine Building Company, of Philadelphia, are considering the propriety of passing their December dividend and utilize the money the payment of it would represent as working capital in the business. Commenting on the report, Morton McMichael, who is a director of the company, says:

"We are doing a great business and making money, and every dollar is needed in operations now under way. The persons comprising the Board of Directors own about 75 per cent. of the stock and conduct its affairs for the best interests of the company. It is only a matter of finance as to whether to pay out money in dividends or hold the funds to carry on business instead of borrowing. It is probably better to use our own funds and distribute them when they are not needed in business."

It is a singular fact that those who note that collections are poor have all the business they can possibly take care of, which goes to show that the situation does not warrant any apprehension. In financial circles the opinion is universal that the stringency in the money market will soon disappear. While immediate relief is thought to be at hand, any doubt that may exist in the matter will be removed on January 1 at the latest, when the payment of dividends on stocks and interests on bonds will put an immense amount of money in circulation, and in ample quantities to meet any adverse condition which may then prevail.

The Board of General Appraisers, to whom was referred on appeal the decision of General Appraiser Jewell decreeing that the duty on German steel billets shall be assessed on the basis of the price they are selling for in Germany for domestic use, has handed down a decision sustaining Mr. Jewell's ruling. This is a defeat for the importers, who contended that the duty should be levied on the basis of what the billets are selling in Germany for export purposes.

The prices of billets for domestic and export uses differ quite widely. Billets in Germany cannot be had, according to the government, for less than 86 marks per 1,000 kilos. The importers, however, produce their invoices showing that they have purchased for export as low as 65 marks per 1,000 kilos, but as a general rule at 10 marks higher at the utmost, yet the government insists on assessing the duty on the basis of 86 marks per 1,000 kilos. The decision in question being final, so far as the customs authorities are concerned, leaves the courts the only avenue open to the importers for redress in the matter, and we understand it is the intention to invoke their aid.

Negotiations are now under way for the consolidation of the principal manufacturers of axles and various edged tools, with a capitalization of $30,000,000, and by the issuance of bonds to the extent of about $11,000,000. It is said that articles of incorporation will be applied for in New Jersey in the near future. The proposed companies are as follows: American Axe & Tool Company, New York; Kelly Axe Manufacturing Company, Alexandria, Ind.; Mann Edge Tool Company, Lewistown, Pa.; James H. Mann, Lewistown, Pa.; Romer Axe Company, Dunkirk, N. Y.; Warren Axe & Tool Company, Warren, Pa.; Standard Axe & Tool Company, Ridgway, Pa.; United States Edge Tool Company, Cattaraugus, N Y.; Indiana Edge Tool Company, Gas City, Ind.; Fayette R. Plumb, Incorporated, Philadelphia, Pa.; Iron City Tool Works, Pittsburgh, Pa.; Warwood Tool Company, Wheeling, W. Va.; Peck Edge Tool Company, Cohoes, N. Y.; Norton Tool Company, Cleveland, Ohio; Winsted Manufacturing Company, Winsted, Conn.; Eagle Scythe Company, Winsted, Conn.; Turner, Day & Woolworth Handle Company, Louisville, Ky.; Southern Handle Company, Huntsville, Ala.; Dunn Edge Tool Company, Oakland, Me.; David Wadsworth & Son, Auburn, N. Y.; Independent Stone Company, Cleveland, Ohio; Klein-Logan Company, Pittsburgh, Pa.; Central Tool Company, Jonesboro, Ind.; Evansville Tool Works, Evansville, Ind.; Welland Vale Manufacturing Company, St. Catharines, Ont.

Through Charles Churchill & Co., London, England, the American Gas Furnace Company, of 23 John street, this city, have received an order for eighteen large annealing and hardening machines, for installation in the British Mint and Woolwich Arsenal. The company were favored with a large order from the same sources several months ago, and its foreign trade in general is assuming gratifying proportions.

At the local offices of the Q. & C. Company, 114 Liberty street, an order has been received for twenty-one Bryant portable saws for the railroad shops of the Japanese Government at Yokohama, Japan.

Hardinge Brothers, of 1036 Lincoln avenue, Chicago, Ill., who are numbered among the oldest and largest chuck manufacturers in the country, have purchased from the A. W. Gump Company, of Dayton, O., the entire Cataract Precision Lathe business, including the name "Cataract Precision Lathe," and will hereafter manufacture this lathe. They are now prepared to receive orders for it, as well as for their well-known sensitive drill press. Hardinge Brothers were recently forced to double their producing capacity to keep up with their increased business.

The United States Coal Company is about to equip its soft-coal mines at Dillonvale, Jefferson county, Ohio, with electrical machinery, and for that purpose recently purchased from the Westinghouse Electric & Manufacturing Company two 150-kilowatt 550-volt direct-current generators and two 10-ton mining locomotives. Electric power will be used for the operation of the locomotives and other mining machinery.

The National Machinery Company, of Tiffin, Ohio, have just completed an order for 300 wire-nail machines for the Colorado Fuel & Iron Company. Other orders amounting to over 250 machines have been filled, and the company is highly gratified with the prospects as well as year's business in the wire-nail machine trade.

The Sherwin-Williams Paint Company, of Cleveland, Ohio, are equipping all their works for electric power distribution. They recently purchased for their Cleveland works three alternating-current generators of 150, 120 and 75 kilowatts capacity, respectively, and about 500 horsepower in induction motors, which will be used to drive all their paint and varnish making machinery. They have also equipped their Newark (N. J.) works with one 75-kilowatt alternating-current engine-type generator and a number of motors, and are about to install a duplicate plant at the same works. At Pullman, Ill., they are putting in a 120-kilowatt alternating-current generator and one of 100 kilowatts and about 200 horse-power in induction motors. The electrical apparatus for the several plants is being furnished by the Westinghouse Electric & Manufacturing Company.

Recent sales of Renold Silent Chain by the Link-Belt Engineering Company include nine line shaft drives from motors for the new works of the Patton Paint Company, Newark, N. J.; eight drives from motors to line shafts and elevators in the new model plant which the Crompton & Knowles Loom Works are erecting in Philadelphia, and eight 60 horse-power drives for induced-draft blowers in the new Waterside Station of the New York Edison Company. There are now sixty-one Renold silent chains in use in the new building of R. H. Macy & Co., varying in capacity from 1 to 90 horse-power.

At the Düsseldorf Exhibition which has just terminated the highest award of merit—the gold medal—was awarded the Hunt conveyor. This conveyor is manufactured by the C. W. Hunt Company, West New Brighton, N. Y.

The smoke nuisance is receiving much attention at the hands of the city authorities of Providence, R. I., who are endeavoring to obtain necessary legislation for its abatement. It is a matter of interest that the three largest industrial concerns in the city have voluntarily encouraged this movement by offering to install apparatus in their power stations which would entirely prevent the formation of black smoke. With this purpose in view the Rhode Island & Suburban Railway has contracted for a large equipment of Roney mechanical stokers for its new boiler plant. The plant will have an ultimate boiler capacity of 8,300 horse-power. The above stokers will be used throughout.

The Shultz Belting Company, of St. Louis, Mo., manufacturers of belting, leather, etc., with local offices at 114 Liberty street, announce that they have just completed remodeling and enlarging their plant at St. Louis, and are now prepared to take orders on a more extensive scale than at any time in their history.

Another large concern—the Narragansett Electric Lighting Company—is also installing a complete equipment of Roney stokers, comprising twelve stokers of the quadruplex type, operating under Babcock & Wilcox boilers of 4,500 horse-power capacity. A third industrial plant employing these stokers is the Brown & Sharpe Manufacturing Company, where Roney stokers under two batteries of Babcock & Wilcox boilers have been in use for some time with excellent results. The success of this installation undoubtedly furnished the incentive toward the smoke prevention movement.

A complete equipment of gas generators, gas engines and direct-connected generators is in process of installation in several important American industrial establishments, viz.; The Winchester Repeating Arms Company, New Haven, Conn.; the Atlantic Refining Company, Philadelphia, Pa.; the Consolidated Industries Company, Batavia, N. Y., and the Rockland Electric Company, Hillburn, N. Y. The first of these equipments to be put in service will be that of the Winchester Repeating Arms Company, at New Haven. The power-house has been specially designed for the new gas apparatus, and the entire power for manufacturing and lighting purposes will be furnished from this point. The engines are of Westinghouse make of the standard vertical three-cylinder single-acting type, aggregating 500 horse-power. They are each direct connected to 250-volt Westinghouse direct-current generators and are furnished with gas fuel from Loomis Pettibone gas generators located in the adjoining producer room. Two additional engines of the vertical type are employed as auxiliaries. Suitable gas holders are provided for insurance of continuity and uniformity of fuel supply.

The power station of the Atlantic Refining Company will be equipped with a new type of Westinghouse gas engine, and a type new to American practice, viz., the horizontal double-crank, double-acting engine. There will be two engines each of 500 horse-power, and each engine will be direct connected to a 550-kilowatt 25-cycle three-phase generator arranged for parallel operation.

The equipment of the Consolidated Industries Company is of interest by reason of the arrangements for the most efficient utilization of the fuel supply. The plant will supply three products, viz., metallurgical coke, fuel gas and electricity. A special process will be used yielding metal-

lurgical coke and fuel gas as a by-product. The electricity for lighting and power purposes will be generated at a central station employing 250 horse-power Westinghouse gas engines of the new horizontal double-acting type direct connected to Westinghouse alternating-current generators operating in parallel and supplying current at 1,100 volts to the distributing network.

Another gas power enterprise and one capable of certain ultimate development is the Rockland Electric Company, which, together with the Ramapo Iron Works and the Ramapo Foundry Company, is comprised in the Snow interests. The installation will consist of an independent gas manufacturing plant employing the Loomis Pettibone process and a power plant containing Westinghouse direct-connected gas engine generator units. The producer plant will supply water gas to the iron plants mentioned for heating and metallurgical purposes, and electric power to all industrial plants in the vicinity, including the Mahwah branch of the Standard Brake Shoe Company, located about four miles distant from Hillburn. The plant will also supply current for lighting throughout the Ramapo Valley district of some 14 miles in extent, comprised between the towns of Ridgewood, N. J., on the south, and Hillburn, N. Y., on the north. The gas engines installed are also of the new Westinghouse horizontal double-acting type of 350 horse-power, each equipment aggregating 1,200 brake horse-power, or 1,240 brake horse-power maximum. The engines are direct connected to Westinghouse polyphase generators and constructed to operate in parallel. A 128 horse-power vertical gas engine unit will also be employed for carrying light loads and assisting at peak loads. The machinery will in all cases be furnished and erected by Westinghouse, Church, Kerr & Co., engineers, New York.

CHICAGO MACHINERY MARKET.

Speaking of the satisfactory condition of trade, a seller of machinists' supplies says that he recently shipped to Detroit on one order 600 gross of drills and that an order for 200 gross for Chicago delivery is not uncommon. These drills are fine, and used largely for drilling vulcanized rubber. The demand for supplies is growing steadily in the West, both in the size and frequency of orders. October was not in every respect a satisfactory month, for some agencies and houses report that the aggregate sales for the month show a slight falling off compared either with the previous months or with the corresponding period last year. But November is starting in for these sellers in a much livelier manner. If there was a restricted use or purchase of supplies in October, it is apparently not to be repeated in November. And the adverse reports alluded to are not general. They are perhaps scarcely common, and where they exist there are often special causes for their existence. Thus the large implement makers, who constitute a considerable percentage of the Western trade in small tools and supplies, have been either delaying their active fall work a little or those that are going into the combination have been busy with inventory and other preliminary work to the neglect of the purchasing departments. These industries are now under full headway, except as they are occasionally interfered with by lack of fuel or material, the latter in itself an index of unusual activity.

The proprietor of a local machine shop says there is a great dearth of good machinists in the shops. This condition is the more seriously felt in the country shops, he says, because the men frequently prefer, for some reason, to live in the larger centers, and when work is so plentiful as now drift into the cities. He alluded to this scarcity of men as an evidence of the extreme activity of shop work. One of his men, he said, had just quit him to go to Europe.

The demand for shop furnishings and fittings is even greater than for supplies, for the market is many-fold broadened, including the equipment of paper mills, cement works, cereal mills, planing mills and factories of great variety, of which a large number are in process of erection. Large work cannot be supplied with any degree of promptness, but fair deliveries can be made on the smaller equipments.

The Chicago office of the L. S. Starrett Company has just completed its first year and reports a steadily growing trade. The Reeves Pulley Company are behind in their orders, though producing facilities are increased. Samuel Harris & Co. are adding to the force in their sales department. The Northampton Emery Wheel Company report an entirely satisfactory trade. These are typical illustrations of market conditions.

The Chicago Pneumatic Tool Company report large sales of pneumatic tools within the last week to the following concerns: Union Pacific Railway Company, Omaha, Neb.; Newport News Shipbuilding & Dry Dock Company, Newport News, Va.; U. S. Navy Yard, Brooklyn, N. Y.; Maryland Steel Company, Sparrows Point, Md.; International & Great Northern Railway, Palestine, Tex.; Standard Oil Company, Buffalo, N. Y.; American Locomotive Company, Brooks Works, Dunkirk, N. Y.; Baldwin Locomotive Works, Philadelphia, Pa.; Seattle, Tacoma & Interurban Railway, Seattle, Wash.; Chicago, Burlington & Quincy Railway, at their Galesburg (Ill.), W. Burlington (Ia.) and Aurora (Ill.) shops; J. I. Case Threshing Machine Company, Racine, Wis.; New York Central & Hudson River Railroad, Depew, N. Y. The above are only a few of their recent sales, and all effected as the result of competitive tests.

Quotations.

NEW YORK, Monday, November 10.

New York prices for Northern and Southern irons for the first half of 1903 are as follows:

Northern:

No. 1 X	$23 25 @ $24 75
No. 2 X	22 00 @ 22 75
No. 2 plain	21 00 @ 21 75

Southern:

No. 1 Foundry	23 25 @ 23 50
No. 2 Foundry	22 25 @ 22 50
No. 3 Foundry	21 50 @ 22 00
No. 4 Foundry	20 50 @ 21 50

Bar Iron—Base sizes—Refined brands, mill price on dock, 1.93c. upward in carload lots. Smaller quantities from store, 2.15 @ 2.20c.

Tool Steel—Base sizes—Good standard quality, 7c.; extra grades, 10c. and upward.

Machinery Steel—Base sizes—From store, 2.10 @ 2.25c.

Cold Rolled Steel Shafting—2.90c. from store for base sizes.

Copper—Lake Superior ingot, 11⅝ @ 11⅞c.; electrolytic and casting, 11½ @ 11¾c.

Pig Tin—In 5- and 10-ton lots, f. o. b. New York, 26⅛ @ 26¼c.

Pig Lead—4.10 @ 4.12½c., in 50-ton lots.

Spelter—5⅜ @ 5½c.

Antimony—Cookson's, 9½c.; Hallett's and U. S., 7¼ @ 7¾c.

Lard Oil—Prime City, 88 @ 91c., according to brand and quantity, ranging from one barrel up to large lots.

Manufacturers.

The grist mill of Frank Crittenden, Buffalo, N. Y., has been burned.

A mill is to be erected in East Astoria, Ore., by the Astoria Fir Company.

Euston & Co., manufacturers of linseed oil, Chicago, will build a linoleum plant.

The wood working factory of Simpson & Peel, Montreal, Que., has been burned.

The National Wood Works will build a sash and door factory in Sioux City, Ia.

The National Horse Nail Company's works in Vergennes, Vt., have been burned.

The Standard Box Factory Company, Portland, Ore., contemplates building a sawmill.

Jewett & Co., manufacturers of stoves and ranges, Buffalo, N. Y., will build a new plant.

The Johnson Forge Company, bar iron, Wilmington, Del., proposes to enlarge its plant.

Forbes & Bro., Hopkinsville, Ky., will erect an additional building to be used as a wagon factory.

A. C. Randolph & Co., manufacturers of stackers, Newton, Ia., will put up additional buildings.

The Toronto (Ont.) Brass Manufacturing Company has received a permit for a five story building.

The Huttig Sash & Door Company, St. Louis, Mo., has bought 5½ acres as a site for a new plant.

The sash and blind mill of the Buchanan & Smock Lumber Company, Asbury Park, N. J., has been burned.

Fire in a dry house of the American Malting Company, Chicago, Ill., caused some damage to machinery.

The flouring mill of Hoffman & Smiley at

Zionsville, Ind., has been burned. A $1,200 engine was practically ruined.

The Champion Candy Machine Company, Philadelphia, Pa., will have a 30x60-foot machine shop added to its plant.

The Denny Envelope & Tag Company, Chicago, has leased an eight-story, 168x100-foot building, which is being erected.

J. E. Porter & Co., manufacturers of hay tools and pumps, Ottawa, Ill., are about to do some building, we understand.

It is stated at Camden, N. J., that electricity is to be substituted for steam wherever practicable in the Pavonia car shops.

A 100x200-foot machine shop is to be built at De Pere, Wis., by the Burns Boiler Company, or a company controlled by it.

The Lester Piano Company, Philadelphia, is having plans made for additions to its factory in Lester (Essington P. O.), Pa.

E. M. Frasier, of Stockton, Cal., has been employed to prepare plans for two cotton factory buildings to be erected there.

Fire at the wood-working mill of F. L. & A. Heidritter, Elizabeth, N. J., has destroyed a number of planers, lathes and scroll saws.

The American Hardware Corporation, New Britain, Conn., has awarded the contract for the erection of a seven-story building, 170x50 feet.

The new Hockensmith Wheel & Wire Car Company, of Irwin, Pa., has purchased five acres of land upon which shops will be erected.

The Benedict & Burnham Manufacturing Company, Waterbury, Conn., brass, etc., will erect a building, 100x200 feet, for casting purposes.

The Rock Falls Manufacturing Company, at Sterling, Ill., will erect a new building to be occupied by the Sterling Silver Plating Company.

There is a rumor afloat that the Baldwin Locomotive Works, of Philadelphia, is considering the removal of its plant to Phillipsburg, N. J.

The site for a power station for the proposed Sidney-Franklin trolley road has been staked out at a point about five miles from Sidney, N. Y.

Charles N. Cox, of Denver, Colo., has been looking over the ground in the neighborhood of Alamosa for a sugar factory proposed to be built in 1903.

The Smith & Egge Manufacturing Company, locks and metal goods, Bridgeport, Conn., has been having plans prepared for an addition to its factory.

Wm. & John Littlejohn, Seneca Falls, N. Y., marble, contemplate building a new factory to be operated by compressed air, the power being furnished from the old one.

The Virginia-Carolina Chemical Company is erecting a $150,000 guano plant at Americus, Ga., and Armour & Co., of Chicago, propose to erect a fertilizer plant there.

The American Grass Twine Company, St. Paul, Minn., is building a large plant at Glendale, Newtown, in Greater New York, for the manufacture of mattresses, matting, etc.

The Beaver Valley Metal Company has been organized to take over the brass foundry of Louis A. Glaser, of New Brighton, Pa. The company will increase the capacity of the plant.

A building is being erected at Norfolk, Va., to be occupied by the Frank T. Clark Company, Ltd., in the builders' supply business. There will be in it some wood-turning lathes, etc., run by electricity.

David Townsend, engineer, Philadelphia, Pa., has plans for a car building plant in Edlystone. The main building will be 300x57 feet; the boiler-house, 50x145 feet, and the office, three stories, 50x100 feet.

A new shop, 125x50 feet, is to be erected for the Clark Machine Company, manufacturer of turbine water wheels, etc., Turner's Falls, Mass. It will be equipped with up-to-date machinery and be run by electrical power.

The Great Lakes Portland Cement Company, capitalized at $3,500,000, has commenced the erection of a 2,000-barrel cement factory at Rogers City, Presque Isle County, Mich. W. F. Cowham, of Saginaw, is the promoter and organizer.

The Allis-Chalmers Company will shortly make important extensions to one of its plants in Chicago. With that end in view the company has purchased a strip with 456 feet of frontage on the east side of Fairfield avenue and 132 feet deep for $39,300.

It is said that the American Manufacturing Company, of Racine, Wis., threshing machine attachments, has consolidated with the Hart-Green Company, and that this will be followed by a plant enlargement, either at the American works or elsewhere.

Miscellaneous Wants.

Advertisements will be inserted under this head at 25 cents a line, each insertion. Copy should be sent to reach us not later than Saturday morning for the ensuing week's issue. Answers addressed to our care will be forwarded.

Gear Wheels, gear cutting. Grant; see p. 54.

Punches & dies. Wal.M.Wks.,Waltham,Mass.

Caliper cat. free. E. G. Smith, Columbia, Pa.

Mfg. plants, space, powers. A. Ela, Boston.

Order your new or special machines from the Industrial Mach. Co., Newark, N. J.

Will buy or pay royalty for good patented machine or tool. Box 282, AMER. MACH.

Light and fine mach'y to order; models and elec. work specialty. E. O. Chase, Newark, N. J.

For Sale—One 36 in. Gould & Eberhardt gear cutter, hand feed; good order. Apply to G. W. Francis, Reading, Pa.

First-class designing, drafting and tracing done to order. Address "Experienced Designer," care AMERICAN MACHINIST.

The Wellman Sole Cutting Machine Co., of Medford, Mass., designs and builds light machinery. Correspondence solicited.

An experienced engineer will perfect, simplify or improve upon articles of manufacture. Address Box 129, AMERICAN MACHINIST.

Wanted—An interest in a hardware, mill supply, machinery or belting business in New York city. Address "Cash," care AM. MACH.

Wanted—A first-class machinery molder for high-grade work in small foundry; $500 to $1,000 stock required. Address D., care A. M.

Light and medium machinery built to order; estimates furnished on all kinds of machine work. F. J. Stokes Machine Co., 13th and Noble sts., Philadelphia, Pa.

For Sale—Working drawings stationary type steam engine, 1 to 40 H.-P., eight sizes; first class in every particular; rare opportunity. Box 134, AMERICAN MACHINIST.

We manufacture on contract patented hardware specialties, tools, dies, metal stampings, special machinery, etc. Edmonds-Metzel Mfg. Co., 778 to 784 W. Lake st., Chicago, Ill.

Grinding beats filing; try us, on either hardened or soft work; capacity 7 in. diameter, 48 in. long and under. The Garvin Machine Co., Spring and Varick sts., New York.

Wanted—Light machine work and special machinery to build to order, special tools, die and punches; a well-equipped water-power plant and first-class workmen. The Bantam Mfg. Co., Bantam, Conn.

Wanted—Machinist, with from $1,000 to $2,000, to take an interest in and the superintendency of a concern manufacturing laundry machinery in Chicago. Address C. T. Cummins, 210 Larrabee st., Chicago, Ill.

Wanted—A large contract to build medium or light automatic machinery; we have the plant, the experience, the capital; cam cutting a specialty; we make the best adjustable reamers. Ott. Mergenthaler Company, Baltimore, Md.

For Sale—New foundry, completely equipped, 60x380, on Erie Canal and Delaware & Hudson Railroad, near Albany; also complete machine shops and forging plant at Troy. Address Pneumatic Signal Company, Broad Exchange, New York.

Purchaser for small manufacturing plant in Madison, Wis.; lot, 100x180 feet; machine shop, 32x68, two story, with line shaft and gasoline power; foundry, 40x54, new modern equipment; good location; for sale cheap. Hart-Parr Co., Charles City, Iowa.

Wants.

Situation and Help Advertisements only inserted under this head. Rate 25 cents a line for each insertion. About six words make a line. No advertisements under two lines accepted, and no advertisements abbreviated. The cash and copy should be sent to reach us not later than Saturday morning for the ensuing week's issue. Answers addressed to our care will be forwarded. Applicants may specify names to which their replies are not to be forwarded; but replies will not be returned. If not forwarded they will be destroyed without notice. Original letters of recommendation or other papers of value should not be enclosed to unknown correspondents.

Situations Wanted.

Machine designer, etc., wants position. Address Box 63, AMERICAN MACHINIST.

Draftsman seeks position; prefers New York. Box 207, AMERICAN MACHINIST.

Mechanical and electrical draftsman wishes position. Box 213, AMERICAN MACHINIST.

As foreman, by A1, progressive pattern-maker. K. G., care AMERICAN MACHINIST.

Experienced mechanical draftsman desires position. Box 192, AMERICAN MACHINIST.

Experienced mechanical draftsman wishes position near New York. Box 210, AM. MACH.

Draftsman, graduate, 3 years' experience, wants position. Box 215, AMER. MACHINIST.

Mechanical draftsman desires position as detailer and tracer, in New York city. Box 216, AMERICAN MACHINIST.

Position as draftsman, by expert machinist; can work at the board or in the shop. Address K. C., care AMERICAN MACHINIST.

Position of responsibility, by competent machine shop or toolroom foreman; A1 references. Box 205, AMERICAN MACHINIST.

Draftsman, age 23; 4 years' shop and office experience; college graduate; terms moderate. Address Box 211, AMERICAN MACHINIST.

Young designing draftsman, with considerable experience, wishes position; engine work preferred. Box 200, AMER. MACHINIST.

A toolmaker and modelmaker on fine work wants position; can take charge of manufacturing. Box 214, AMERICAN MACHINIST.

Young Swede, with 8½ years' shop and drawing-office experience, wishes to change position. Box 193, AMERICAN MACHINIST.

Young man, having 4 years' experience in machine shop, desires position where he can gain more knowledge. Box 202, AM. MACH.

Manufacturing engineer; labor-saving methods; special tools, jigs, etc.; correspondence solicited. Eugene Wilson, care AM. MACH.

Mechanical draftsman, technical graduate, 3 years' shop and drawing-room experience, desires change of situation. Box 196, AM. M.

Salesman of Chicago, familiar with machinery and tools, desires to represent manufacturer, traveling or local. Address Box 194, AMERICAN MACHINIST.

A mechanical draftsman and practical machinist, with good knowledge of the foundry and patternmaking, desires responsible position; age 30. Box 188, AMER. MACH.

Situation wanted by an experienced mechanic, as foreman or superintendent; familiar with the details of mechanical drawing. Address C. C., care AMERICAN MACHINIST.

Draftsman—Young man; few years' experience; technical graduate; good detail delineator and A1 tracer; also little experience in automobile work. Box 201, AMER. MACH.

Position wanted as foreman of screw machine department; 10 years' experience as foreman of departments, including hand and automatics. Box 208, AMER. MACHINIST.

Position as superintendent or foreman of machine shop, by man having had 20 years' practical experience; 8 in charge; best of reference. Box 199, AMERICAN MACHINIST.

Mechanical engineer; experienced in equipping and managing shops; specialty, designing tools for rapid manufacture of repetition work; can develop small automatic casting process. Address Box 157, AMER. MACH.

Expert on automatic machinery, light and heavy; first-class designer; inventive ability; 10 years' best experience; graduate; fitted for head draftsman, superintendent or to develop inventions; terms moderate. Box 187, A. M.

Experienced correspondent and typewriter (English, French, German, Spanish) seeks responsible position with machinery firm in the United States; age 26 years; first-class references. Address C. F., 100 Bd. National, Clichy (Paris), France.

Position wanted as general foreman or superintendent; now employed, but desiring change; modern, up-to-date ideas and a cost-cutter and organizer; medium or heavy machinery or machine tools; Middle States preferred. Address Box 195, AMER. MACHINIST.

Wanted—Position, by a thoroughly well posted and competent salesman; accustomed to closing large contracts, familiar with modern machinery and especially adapted to introduce a new line of goods or to open up new territory. Box 98, AMER. MACHINIST.

Young mechanical engineer; technical education; experience in shops, drawing room and on the road; at present employed as editor of engineering magazine, but wishes change; is a hustler and can get along with people; references from past and present employers. Anyone desiring he services of such a man address Box 13, AMER. MACHINIST.

"Australian."—A pushing young Australian, age 28, accountant, member of engineering firm, 10 years' Melbourne experience, would like communicate with firm to whom his knowledge of Australian trade would be of value, with object employment, view obtaining American experience. Papers, photo., particulars, etc., at office of AMERICAN MACHINIST. Address Box 197.

Mechanical engineer, graduate Mass. Inst. of Technology, with shop and drafting-room experience in modern shop making interchangeable work, would like change in position; has had experience in handling work and men under both piece-work and premium systems and in estimating on contract work; can design jigs and lay out manufacturing processes; position as superintendent or assistant superintendent preferred. Address Box 139, AMERICAN MACHINIST.

Help Wanted.

Machinists—Your inventions developed by G. M. Mayer, M. E., Monadnock, Chicago.

More machinists, to introduce my double jaw caliper system. Address E. G. Smith, Columbia, Pa.

Wanted—First-class machinists, in city near Philadelphia; steady work and good pay. The Reeves Engine Co., Trenton, N. J.

Wanted—First-class, non-union, all-round machinist; good shop and tools; work every day in the year. Box 190, AMER. MACHINIST.

Draftsmen.—Wanted—Two good men; permanent position and good wages. Apply Fournier-Searchmont Automobile Co., Trainer, Pa.

Toolmakers wanted on jig and fixture work; high-grade men only need apply. Call on or address the Taft-Peirce Mfg. Co., Woonsocket, R. I.

Wanted—An experienced operator on a 36 in. three-head Ingersoll milling machine; must be an accurate worker. De Laval Steam Turbine Co., Trenton, N. J.

Wanted—All kinds experienced engineers, draftsmen; send stamp to register; positions open. Cleveland Engineering Agency, Box 71, Station B, Cleveland, O.

A1 machine hands on Gisholt lathe and screw machine can secure good, steady job by applying immediately to Central City Iron Works, Stevens Point, Wis.

Working foreman, in Brooklyn; all-around man, capable of first-class work; state wages, nationality, age and full particulars. Address Box 209, AMERICAN MACHINIST.

Wanted—Positions for experienced men, and men for such positions. Address James Brady (late Brady Mfg. Co.), Room J, 20th Floor, 220 Broadway, New York.

Wanted—Lathe and planer hands for night work on heavy machine tool work; good wages to good men. Apply to The Pond Machine Tool Company, Plainfield, N. J.

Wanted—An energetic, practical man as general foreman in large textile machine shop; state age, experience, qualifications and salary. P. O. Box 2815, Boston, Mass.

Wanted—Designer of small electric and mechanical apparatus; must be good draftsman and thoroughly competent engineer; state experience fully. Box 198, AMER. MACHINIST.

Wanted—A young man to take care of order book in a jobbing foundry; must be familiar with patterns and core boxes; steady work at good wages. Box 191, AMER. MACHINIST.

Good mechanical draftsman with designing ability wanted in large manufacturing company; state age, education experience and salary expected. Address Box 206, AM. MACH.

Wanted—First-class iron-working machinery salesman; but little traveling required; all correspondence treated confidentially. Address, with references, Northern Machinery Co., Minneapolis, Minn.

Wanted—First-class grinder; sewing machine work; must thoroughly understand Brown & Sharpe automatic grinder; state experience and salary expected. Address "Opportunity," care AMERICAN MACHINIST.

Wanted—Man experienced in the operation of universal grinding machines, and with good general mechanical ideas; experimental work; state age, experience, references and salary expected. Box 212, AMERICAN MACHINIST.

We are constantly increasing the scope of our work, and invite applications for positions from first-class patternmakers, molders and machinists; we always have vacancies. Address The Westinghouse Machine Company, East Pittsburg, Pa.

Wanted—Machinists, toolmakers, floor hands, bodymakers, painters, trimmers and blacksmiths; we have just moved into our new factory and will double our present force; good wages and 9 hours' work. Address Fournier-Searchmont Automobile Company, Trainer, Delaware County, Pa.

Wanted—Engineer for small steam and electric plant, 20 miles from New York; must be capable taking charge of steam, hydraulic and electric machinery and storage battery; have some knowledge of drawing; must speak German; state experience, references, wages, etc. Address "Factory," P. O. Box 6, Branch O, New York City.

Wanted—Two or three first-class floor hands on fitting and erecting heavy machinery, one turret lathe operator and one first-class planer hand; good wages and steady employment; none but first-class workmen need appiy. Address Farrel Foundry & Machine Co., Ansonia, Conn., giving age, experience and wages required.

Wanted—A man familiar with modern methods of manufacturing light machinery on the interchangeable system, to take the position of assistant foreman in a factory employing 250 men, in the city of Chicago; one having tact, energy and the ability to produce the highest grade of work at a minimum cost, desired. Box 203, AMERICAN MACHINIST.

Wanted—Machinists for night work, of all branches of the trade, such as toolmakers, hands on lathes, planers, boring mills, milling machines, universal grinders; Gisholt, Potter & Johnston and all other types of chucking and screw machines, floor, vise, etc.; steady work for first-class men on light and medium interchangeable work. De Laval Steam Turbine Co., Trenton, N. J.

Wanted—A manager and superintendent of a large machine shop manufacturing machines under their own patents; must be a man thoroughly experienced in machine work and of good business ability; salary and other inducements will be offered; the company is doing a fine business and wants the services of a bright, energetic and experienced man; all communications confidential. Address, giving full particulars, to P. T. D., care AM. MACH.

Wanted—A young man to act as correspondence clerk in a manufacturing establishment; one who is skillful in the use of the typewriter, whose tastes are mechanical and along literary lines, with ability to do cataloging, edit advertisements, circulars and other printed matter that may be necessary in connection with a line of special machinery; give age, experience, salary expected, references, etc. Address Box 204, AMER. MACHINIST.

Wanted—Tool maker, one having had practical experience in making tools, such as drilling, milling and planing jigs for duplicate parts of medium size machinery; must have had experience in designing tools as well as in drafting; must also be able to look after several men in tool-making department; a knowledge of German preferred, but not absolutely necessary. Answer, if possible in German, stating experience, where last employed, whether married or single and what wages last received, to N. W., No. 999, Postlagernd, Francfort a. M., Germany.

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Norton Emery Wheel Co., Worcester, Mass.

Arbor Presses

Barnes Co., W. F. & John, Rockford, Ill.
Bartlett, E. E., Boston, Mass.

Ball Bearings

See Roller Bearings.

Balls, Steel

Federal Mfg. Co., Cleveland, O.

Band Saws

American Machinery Co., Grand Rapids, Mich.

Barrels, Steel

Cleveland Wire Spring Co., Cleveland, O.
Kilbourne & Jacobs Mfg. Co., Philadelphia, Pa.

Bars, Boring

Cleveland Twist Drill Co., Cleveland, O.
Underwood & Co., H. B., Philadelphia, Pa.

Belt Dressing

Dixon Crucible Co., Jos., Jersey City, N. J.
Houghton & Co., E. F., Philadelphia, Pa.

Belt Lacing Machines

Diamond Drill & Mach. Co., Birdsboro, Pa.

Belting, Leather

Shultz Belting Co., St. Louis, Mo.

Bending Machines, Power

Bethlehem Foundry & Mach. Co., So. Bethlehem, Pa.
National Mchry. Co., Tiffin, O.
Reade Mchry. Co., Cleveland, O.

Bending Machines, Hydraulic

Bement, Miles & Co., New York.
Watson-Stillman Co., New York.

Blocks and Tackles

See Hoists, Hand.

Blowers

Am. Gas Furnace Co., N. Y. City.
Buffalo Forge Co., Buffalo, N. Y.
Champion Blower & Forge Co., Lancaster, Pa.

Boilers

Chandler & Taylor Co., Indianapolis, Ind.
Struthers, Wells & Co., Warren, Pa.

Bolt and Nut Machinery

Acme Mchry. Co., Cleveland, O.
Detrick & Harvey Mach. Co., Baltimore, Md.
Howard Iron Wks., Buffalo, N. Y.
National Mchry. Co., Tiffin, O.
Pratt & Whitney Co., Hartford, Conn.
Ray Automatic Mach. Co., Cleveland, O.
Reliance Mach. & Tool Co., Cleveland, O.
Webster & Ferks Tool Co., Springfield, O.
Wells Bros. Co., Greenfield, Mass.

Books, Mechanical

Baird & Co., Henry Carey, Philadelphia, Pa.
Derry-Collard Co., New York.
Henley & Co., N. W., New York.
Van Nostrand Co., D., New York.
Wiley & Sons, John, New York.

Boring and Turning Mills

American Tool Wks. Co., Cin., O.
Baush Mach. Tool Co., Springfield, Mass.
Bement, Miles & Co., New York.
Betts Mach. Co., Wilmington, Del.
Bullard Mach. Tool Co., Bridgeport, Conn.
Hill, Clarke & Co., Boston, Mass.
McCabe, J. J., New York.
Niles Tool Works Co., New York.
Pond Mach. Tool Co., New York.
Prentiss Tool & Supply Co., New York.
Warner & Swasey Co., Cleveland, Ohio.

Boring and Drilling Machines, Horizontal

Barnes Co., B. F., Rockford, Ill.
Barnes Co., W. F. & John, Rockford, Ill.
Beaman & Smith Co., Provi., R. I.
Bement, Miles & Co., N. Y. City.
Betts Mach. Co., Wilmington, Del.
Binsse Mach. Co., Newark, N. J.
Dallett & Co., Thos. H., Phila., Pa.
Detrick & Harvey Mach. Co., Baltimore, Md.
Fosdick Mach. Tool Co., Cincinnati, O.
Franklin Mach. Wks., Phila., Pa.
McCabe, J. J., New York.
Newton Mach. Tool Wks., Philadelphia, Pa.
Niles Tool Works Co., New York.
Pond Mach. Tool Co., New York.
Pratt & Whitney Co., Hartford, Conn.
Prentiss Tool & Supply Co., New York.
Warner & Swasey Co., Cleveland, Ohio.

Bulldozers

National Mchry. Co., Tiffin, O.

Carborundum

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Car Link Machines

National Machy. Co., Tiffin, O.

Castings, Brass and Bronze

Christensen Engineering Co., Milwaukee, Wis.
Miami Brass Wks., Hamilton, O.

Castings, Die Molded

Franklin Mfg. Co., Syracuse, N. Y.

Castings, Motor

Giant Motor Co., Elizabeth, N. J.

Castings, Steel

Christensen Engineering Co., Milwaukee, Wis.
Uniform Steel Co., Newark, N. J.

Centers, Planer

Fay & Scott, Dexter, Me.
New Haven Mfg. Co., New Haven, Conn.
Pratt & Whitney Co., Hartford, Conn.
Reed Co., F. E., Worcester, Mass.

Centering Machine

Bement, Miles & Co., New York.
Kempsmith Mfg. Co., Milwaukee, Wis.
Niles Tool Works Co., New York.
Pond Mach. Tool Co., New York.
Whiton Machine Co., D. E., New London, Conn.

Chains, Driving

Boston Gear Works, Boston, Mass.
Federal Mfg. Co., Cleveland, O.
Bridgeport Chain Co., Bridgeport, Conn.
Jeffrey Mfg. Co., The, Columbus, Ohio.
Link Belt Engr. Co., Phila., Pa.
Morse Chain Co., Trumansburg, N. Y.
Whitney Mfg. Co., Hartford, Ct.

Chucking Machines

Brown & Sharpe Mfg. Co., Providence, R. I.
Cleveland Automatic Mach. Co., Cleveland, O.
Le Blond Mach. Tool Co., R. K., Cincinnati, O.
Potter & Johnston Mach. Co., Pawtucket, R. I.
Pratt & Whitney Co., Hartford, Conn.
Reed Co., F. E., Worcester, Mass.
Warner & Swasey Co., Cleveland, Ohio.
Windsor Mach. Co., Windsor, Vt.

Chucks, Drill

Almond, T. R., Brooklyn, N. Y.
Brown & Co., R. H., New Haven, Conn.
Cleveland Twist Drill Co., Cleveland, O.
Cushman Chuck Co., Hartford, Ct.
Goodell-Pratt Co., Greenfield, Mass.
The E. Horton & Sons Co., Windsor Locks, Conn.
Morse Twist Drill & Mch. Co., New Bedford, Mass.
Pratt Chuck Co., Frankfort, N. Y.
Standard Tool Co., Cleveland, O.
Trump Bros. Mach. Co., Wilmington, Del.
Whitney Mfg. Co., Hartford, Ct.
Whiton Mach. Co., D. E., New London, Conn.

Chucks, Lathe
Cushman Chuck Co., Hartford, Ct.
Hoggson & Pettis Mfg. Co., New Haven, Conn.
The E. Horton & Son Co., Windsor Locks, Conn.
Pratt & Whitney Co., Hartford, Conn.
Skinner Chuck Co., New Britain, Conn.
Westcott Chuck Co., Oneida, N. Y.
Whiton Mach. Co., D. E., New London, Conn.

Chucks, Scroll
Whiton Mach. Co., D. E., New London, Conn.

Chucks, Split
Faneuil Watch Tool Co., Boston, Mass.

Clutches, Friction
Caldwell, Son & Co., H. W., Chicago, Ill.
Coil Clutch Mfg. Co., New York.
Faneuil Watch Tool Co., Boston, Mass.
Jacobson Mach. Mfg. Co., Warren, Pa.
New Haven Mfg. Co., New Haven, Conn.
Oesterlein Mach. Co., Cincin., O.
Patterson, Gottfried & Hunter, Ltd., New York.
Pratt & Whitney Co., Hartford, Conn.

Compressors, Air
Blanchard Mach. Co., Boston, Mass.
Chicago Pneumatic Tool Co., Chicago, Ill.
Christensen Engineering Co., Milwaukee, Wis.
Gray-Blaisdell Co., Bradford, Pa.
Herron & Bury Mfg. Co., Erie, Pa.
Ingersoll-Sergeant Drill Co., New York.
Jacobson Mach. Mfg. Co., Warren, Pa.
Rand Drill Co., New York.

Consulting Engineer
Thompson, Hugh L., Waterbury, Conn.

Coping Machines
Long & Allstatter Co., Hamilton, Ohio.

Correspondence Schools
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Countershafts
Builders' Iron Fdry., Provl., R. I.
Oesterlein Mach. Co., Cincin., O.
Power & Speed Regulator Mfg. Co., Kalamazoo, Mich.
Pratt & Whitney Co., Hartford, Conn.
Reeves Pulley Co., Columbus, Ind.
Wilmarth & Morman Co., Grand Rapids, Mich.

Counters, Machinery
Veeder Mfg. Co., Hartford, Conn.

Counting and Printing Wheels
Franklin Mfg. Co., Syracuse, N. Y.

Couplings, Shaft
Caldwell & Son Co., H. W., Chicago, Ill.
Cresson Co., Geo. V., Philadel., Pa.
Davis Mach. Co., W. P., Rochester, N. Y.
Patterson, Gottfried & Hunter, Ltd., New York.
Stuart, R. J., New Hamburg, N. Y.

Cranes
Brown Hoisting Mach. Co., N. Y. City.
Chicago Pneumatic Tool Co., Chicago, Ill.
Cleveland Crane & Car Co., Cleveland, O.
Franklin Portable Crane & Hoist Co., Franklin, Pa.
Maris Bros., Philadelphia, Pa.
Niles-Bement-Pond Co., New York.
Northern Engineering Works, Detroit, Mich.
Pawling & Harnischfeger, Milwaukee, Wis.
Sellers & Co., Wm., Philadel., Pa.
Whiting Foundry Equipment Co., Harvey, Ill.

Crucibles
Dixon Crucible Co., Jos., Jersey City, N. J.

Cupolas, and Ladles, Foundry
Northern Engr. Works, Detroit, Mich.
Obermayer Co., S., Cincinnati, O.
Whiting Foundry Equip. Co., Harvey, Ill.

Cutters, Milling
Brown & Sharpe Mfg. Co., Providence, R. I.
Cleveland Twist Drill Co., Cleveland, O.
Gay & Ward, Athol, Mass.
Ingersoll Milling Mach. Co., Rockford, Ill.
Morse Twist Drill & Mach. Co., New Bedford, Mass.
Rogers, John M., Boat, Gage & Drill Works, Gloucester City, N. J.
Standard Tool Co., Cleveland, O.

Cutting-off Machines
Bement, Miles & Co., New York.
Brown & Sharpe Mfg. Co., Providence, R. I.
Davenport-McCullough Mfg. Co., Blissfield, Mich.
Davis Mach. Co., W. P., Rochester, N. Y.
Franklin Mach. Wks., Phila., Pa.
Hurlbut-Rogers Mach. Co., South Sudbury, Mass.
Newton Mach. Tool Wks., Philadelphia, Pa.
Niles Tool Works Co., New York.
Pond Mach. Tool Co., New York.

Cutting off Tools
Armstrong Bros. Tool Co., Chicago, Ill.
Pratt & Whitney Co., Hartford, Conn.

Cyclometers
Veeder Mfg. Co., Hartford, Conn.

Dies, Sheet Metal
Bliss Co., E. W., Brooklyn, N. Y.
Perkins Mach. Co., So. Boston, Mass.
Toledo Mach. & Tool Co., Toledo, Ohio.
Wold & Co., Torris, Chicago, Ill.

Dies, Threading, Opening
Errington, F. A., New York.
Geometric Drill Co., New Haven, Conn.
Jones & Lamson Mch. Co., Springfield, Vt.
Pratt & Whitney Co., Hartford, Conn.

Dowel Pins
Winkley Co., Hartford, Conn.

Drawing Boards and Tables
Zacharias, E. M., Brooklyn, N. Y.

Drawing Instruments
Keuffel & Esser Co., New York.

Drilling Machines, Bench
Barnes Co., W. F. & John, Rockford, Ill.
Pratt & Whitney Co., Hartford, Conn.

Drilling Machines, Boiler
Baush Mch. Tool Co., Springfield, Mass.
Bickford Drill & Tool Co., Cincinnati, O.
Bement, Miles & Co., New York.
Dallett & Co., Thos. H., Phila., Pa.
Niles Tool Works Co., New York.
Pond Mach. Tool Co., New York.
Prentice Bros. Co., Worcester, Mass.

Drilling Machines, Multiple Spindle
Baker Bros., Toledo, O.
Barnes Co., B. F., Rockford, Ill.
Barnes Co., W. F. & John, Rockford, Ill.
Baush Mch. Tool Co., Springfield, Mass.
Bement, Miles & Co., New York.
Bickford Drill & Tool Co., Cincinnati, Ohio.
Dallett & Co., Thos. H., Phila., Pa.
Garvin Mach. Co., New York.
Harrington, Son & Co., Edwin, Philadelphia, Pa.
McCabe, J. J., New York.
Marshall & Huschart Mchry. Co., Chicago, Ill.
Newton Machine Tool Works, Philadelphia, Pa.
Niles Tool Works Co., New York.
Prentice Bros. Co., Worcester, Mass.
Prentiss Tool & Supply Co., New York.

Drilling Machines, Pneumatic
Chicago Pneumatic Tool Co., Chicago, Ill.
Cleveland Pneu. Tool Co., Cleveland, Ohio.
Phila. Pneumatic Tool Co., Philadelphia, Pa.
Prentice Bros. Co., Worcester, Mass.
Q & C Co., Chicago, Ill.
Standard Ry. Equip. Co., St. Louis, Mo.

Drilling Machines, Portable
Dallett & Co., Thos. H., Phila., Pa.

Drilling Machines, Radial
American Tool Wks. Co., Cin., O.
Baush Mch. Tool Co., Springfield, Mass.
Bement, Miles & Co., New York.
Bickford Drill & Tool Co., Cincinnati, Ohio.
Cleveland Punch & Shear Works Co., Cleveland, O.
Dreses Mach. Tool Co., Cincin., O.
Fosdick Mach. Tool Co., Cincin., O.
Gang Co., Wm. E., Cincinnati, O.
Harrington, Son & Co., Edwin, Philadelphia, Pa.
Hill, Clarke & Co., Boston, Mass.
McCabe, J. J., New York.
Marshall & Huschart Mchry. Co., Chicago, Ill.
Mueller Mach. Tool Co., Cincin., O.
Niles Tool Works Co., New York.
Pond Mach. Tool Co., New York.
Prentice Bros. Co., Worcester, Mass.
Prentiss Tool & Supply Co., New York.
Reade Mchry Co., Cleveland, O.

Drilling Machines, Turret
Niles Tool Works Co., New York.
Quint, A. D., Hartford, Conn.
Vanderbeek Tool Wks., Hartford, Conn.

Drilling Machines, Upright
American Tool Wks. Co., Cin., O.
Baker Bros., Toledo, O.
Barnes Co., B. F., Rockford, Ill.
Barnes Co., W. F. & John, Rockford, Ill.
Bement, Miles & Co., New York.
Cincinnati Mach. Tool Co., Cin., O.
Davis Mach. Co., W. P., Rochester, N. Y.
Dwight Slate Mach. Co., Hartford, Conn.
Fosdick Mach. Tool Co., Cincinnati, O.
Gould & Eberhardt, Newark, N. J.
Harrington & Son Co., Edwin, Philadelphia, Pa.
Hill, Clarke & Co., Boston, Mass.
Hoefer Mfg. Co., Freeport, Ill.
Le Blond Mach. Tool Co., R. K., Cincinnati, O.
McCabe, J. J., New York.
Marshall & Huschart Mchry. Co., Chicago, Ill.
Niles Tool Works Co., New York.
New Haven Mfg. Co., New Haven, Conn.
Power & Speed Regulator Mfg. Co., Kalamazoo, Mich.
Pratt & Whitney Co., Hartford, Conn.
Prentice Bros. Co., Worcester, Mass.
Prentiss Tool & Supply Co., New York.
Reed Co., Francis, Worcester, Mass.
Sibley & Ware, South Bend, Ind.
Washburn Shops, Worcester, Mass.

Drills, Center
Pratt & Whitney Co., Hartford, Conn.
Slocomb & Co., J. T., Providence, R. I.

Drills, Rail
Bement, Miles & Co., New York.
Niles Tool Works Co., New York.

Drills, Ratchet
Parker Co., Chas. Meriden, Ct.
Pratt & Whitney Co., Hartford, Conn.

Dust Collectors
Allington & Curtis Mfg. Co., Saginaw, Mich.

Dynamos
Akron Elec. Mfg. Co., Akron, O.
C & C Electric Co., New York.
Crocker-Wheeler Electric Co., Ampere, N. J.
Eck Dynamo & Motor Co., Belleville, N. J.
General Elec. Co., New York.
Jantz & Leist Elec. Co., Cincin., O.
Mechanical Appliance Co., Milwaukee, Wis.
Northern Elec. Mfg. Co., Madison, Wis.
Robbins & Myers Co., Springfield, Ohio.
Sprague Elec. Co., New York.
Triumph Elec. Co., Cincinnati, O.
Western Electric Co., Chicago, Ill.
Westinghouse Electric & Mfg. Co., Pittsburgh, Pa.

Electrical Supplies
Akron Elec. Mfg. Co., Akron, O.
General Elec. Co., New York.
Triumph Electric Co., Cincin., O.
Western Electric Co., Chicago, Ill.
Westinghouse Elec. & Mfg. Co., Pittsburgh, Pa.

Elevators
Albro-Clem Elevator Co., Philadelphia, Pa.
Howard Iron Wks., Buffalo, N. Y.
Morse, Williams & Co., Phila., Pa.

Emery Wheels
See Grinding Wheels.

Enclosures, Tool-room
Merritt & Co., Philadelphia, Pa.

Engines, Gas and Gasoline
Columbus Mach. Co., Columbus, O.
Cooper Mach. Co., Saltsburg, Pa.
Elyria Engine Co., Elyria, O.
Foos Gas Eng. Co., Springfield, O.
Mletz, August, New York.
National Engine Co., Rockford, Ill.
New England Gas Engine Co., Boston, Mass.
New Era Iron Wks., Dayton, O.
Olds Motor Wks., Lansing, Mich.
Patterson, Gottfried & Hunter, Ltd., New York.
Regal Gasoline Engine Co., Coldwater, Mich.
Springfield Gas Eng. Co., Springfield, O.
Stover Engine Works, Freeport, Ill.
Struthers, Wells & Co., Warren, Pa.

Engines, Steam
Buffalo Forge Co., Buffalo, N. Y.
Chandler & Taylor Co., Indianapolis, Ind.
Frick Co., Waynesboro, Pa.
Rand Drill Co., New York.
Struthers, Wells & Co., Warren, Pa.

Exhaust Fans
Buffalo Forge Co., Buffalo, N. Y.

Fans, Electric
General Electric Co., New York.
Northern Elec. Mfg. Co., Madison, Wis.
Sprague Elec. Co., New York.
Western Electric Co., Chicago, Ill.
Westinghouse Elec. & Mfg. Co., Pittsburgh, Pa.

Files and Rasps
Barnett Co., G. & H., Phila., Pa.
Etna Mfg. Co., New York.
Hammacher, Schlemmer & Co., New York.
Nicholson File Co., Provl., R. I.

Filing Machines
Cochrane-Bly Mach. Co., Rochester, N. Y.

Fillers, Oil Can
The Winkley Co., Hartford, Conn.

Fittings, Steam
Crane Co., Chicago, Ill.
Crosby Steam Gage & Valve Co., Boston, Mass.
Jenkins Bros., New York.
Lunkenheimer Co., Cincinnati, O.
Walworth Mfg. Co., Boston, Mass.

Flexible Shafts
Chicago Flexible Shaft Co., Chicago, Ill.

Forges
Buffalo Forge Co., Buffalo, N. Y.

Forgings, Drop
Billings & Spencer Co., Hartford, Conn.
Wyman & Gordon, Worcester, Mass.

Forgings, Hydraulic
Wyman & Gordon, Worcester, Mass.

Forgings, Steel
Wyman & Gordon, Worcester, Mass.

Foundry Furnishings
Obermayer Co., S., Cincinnati, O.
Whiting Foundry Equip. Co., Harvey, Ill.

Furnaces, Coal, Gas and Oil
Am. Gas Furnace Co., N. Y. City.
Buffalo Forge Co., Buffalo, N. Y.
Chicago Flexible Shaft Co., Chicago, Ill.
Jacobson Mach. Mfg. Co., Warren, Pa.

Furniture, Machine Shop
New Britain Mach. Co., New Britain, Conn.

Gages, Recording
Bristol Co., Waterbury, Conn.

Gages, Standard
Brown & Sharpe Mfg. Co., Providence, R. I.
Rogers, John M., Boat, Gage & Drill Works, Gloucester City, N. J.
Sawyer Tool Mfg. Co., Fitchburg, Mass.
Slocomb & Co., J. T., Prov., R. I.
Starrett Co., L. S., Athol, Mass.

Gages, Steam
Crosby Steam Gage & Valve Co., Boston, Mass.

Gas Producers
Am. Gas Furnace Co., N. Y. City.

Gear Cutting Machinery
Bickford Drill & Tool Co., Cin., O.
Brown & Sharpe Mfg. Co., Providence, R. I.
Dwight Slate Mach. Co., Hartford, Conn.
Fellows Gear Shaper Co., Springfield, Vt.
Gleason Tool Co., Rochester, N. Y.
Gould & Eberhardt, Newark, N. J.
Harrington & Son Co., Edwin, Philadelphia, Pa.
Newton Mch. Tool Wks., Phil., Pa.
Niles Tool Works Co., New York.
Whiton Machine Co., D. E., New London, Conn.

Gears, Cut
Bilgram, Hugo, Philadelphia, Pa.
Boston Gear Wks., Boston, Mass.
Brown & Sharpe Mfg. Co., Providence, R. I.
Cleveland Gear Wks., Cleveland, O.
Fawcus Mach. Co., Pittsburgh, Pa.
Fellows Gear Shaper Co., Springfield, Vt.
Gleason Tool Co., Rochester, N. Y.
Gould & Eberhardt, Newark, N. J.
Grant Gear Works, Boston, Mass.
Harrington, Son & Co., Edwin, Philadelphia, Pa.
Horsburgh & Scott, Cleveland, O.
New Process Raw Hide Co., Syracuse, N. Y.
Nuttall Co., R. D., Pittsburgh, Pa.
Philadelphia Gear Works, Philadelphia, Pa.
Saunders Mfg. Co., Dayton, O.
Simonds Mfg. Co., Pittsburgh, Pa.

Gears, Molded
Caldwell & Son Co., H. W., Chicago, Ill.
Franklin Mfg. Co., Syracuse, N. Y.
Greenwald Co., I. & E., Cincin., O.
Poole & Son Co., Robt., Baltimore, Md.

Gears, Rawhide
Chicago Raw Hide Co., Chicago, Ill.
Fawcus Mch. Co., Pittsburgh, Pa.
New Process Raw Hide Co., Syracuse, N. Y.
Nuttall Co., R. D., Pittsburgh, Pa.

Gears, Worm
Albro-Clem Elevator Co., Philadelphia, Pa.
Fawcus Mach. Co., Pittsburgh, Pa.
Morse, Williams & Co., Phila., Pa.
Nuttall Co., R. D., Pittsburgh, Pa.
Simonds Mfg. Co., Pittsburgh, Pa.

Graphite
Dixon Crucible Co., Jos., Jersey City, N. J.
Lubriphite Co., Jersey City, N. J.
Obermayer Co., S., Cincinnati, O.

Grinders, Center
Heald & Son, L. S., Barre, Mass.

Grinders, Cock
Windsor Mach. Co., Windsor, Vt.

Grinders, Cutter
Adams Co., Dubuque, Iowa.
Automatic Mach. Co., Greenfield, Mass.
Brown & Sharpe Mfg. Co., Providence, R. I.
Cincinnati Milling Mach. Co., Cincinnati, O.
Garvin Machine Co., New York.
Norton Emery Wheel Co., Worcester, Mass.
Oesterlein Mach. Co., Cincin., O.
Pratt & Whitney Co., Hartford, Conn.
Rivett-Dock Co., Boston, Mass.

Grinders, Disc
Besly & Co., Chas. H., Chicago, Ill.
Gorton Mach. Co., Geo., Racine, Wis.
Iroquois Mach. Co., Provi., R. I.

Grinders, Drill
Gorton Mach. Co., Geo., Racine, Wis.
Heald & Son, L. S., Barre, Mass.
Standard Tool Co., Cleveland, O.
Washburn Shops, Worcester, Mass.
Wilmarth & Morman Co., Grand Rapids, Mich.

Grinders, Tool
Barnes Co., B. F., Rockford, Ill.
Barnes Co., W. F. & John, Rockford, Ill.
Brown & Sharpe Mfg. Co., Providence, R. I.
Diamond Mach. Co., Prov., R. I.
Gisholt Mach. Co., Madison, Wis.
Iroquois Mach. Co., Provi., R. I.
Landis Tool Co., Waynesboro, Pa.
Northampton Emery Wheel Co., Leeds, Mass.
Oesterlein Mach. Co., Cincin., O.
Safety Emery Wheel Co., Springfield, O.
Whitney Mfg. Co., Hartford, Ct.

Grinding Machines
Besly & Co., Chas. H., Chicago, Ill.
Brown & Sharpe Mfg. Co., Providence, R. I.
Builders' Iron Foundry, Providence, R. I.
Diamond Mach. Co., Prov., R. I.
Falkenau-Sinclair Co., Phila., Pa.
Frasse Co., New York.
Goodell-Pratt Co., Greenfield, Mass.
Gorton Mach. Co., Geo., Racine, Wis.
Greenfield Mach. Co., Greenfield, Mass.
Hill, Clarke & Co., Boston, Mass.
Iroquois Mach. Co., Prov., R. I.
Landis Tool Co., Waynesboro, Pa.
Marshall & Huschart Mchry. Co., Chicago, Ill.
Northampton Emery Wheel Co., Leeds, Mass.
Northern Elec. Mfg. Co., Madison, Wis.
Norton Emery Wheel Co., Worcester, Mass.
Prentiss Tool & Supply Co., New York.
Safety Emery Wheel Co., Springfield, Ohio.
Tanite Co., Stroudsburg, Pa.
Washburn Shops, Worcester, Mass.
Webster & Perks Tool Co., Springfield, O.
Wilmarth & Morman Co., Grand Rapids, Mich.

Grinding Wheels
Abrasive Material Co., Phila., Pa.
Builders' Iron Foundry, Providence, R. I.
Carborundum Co., Niagara Falls, N. Y.
Diamond Mach. Co., Provi., R. I.
Hampden Cor. Wheel Co., Brightwood, Mass.
Northampton Emery Wheel Co., Leeds, Mass.
Norton Emery Wheel Co., Worcester, Mass.
Safety Emery Wheel Co., Springfield, O.
Tanite Co., Stroudsburg, Pa.

Grindstones
Cleveland Stone Co., Cleveland, O.
Lombard & Co., Boston, Mass.

Gun Barrel Machinery
Bement, Miles & Co., New York.
Diamond Mach. Co., Provi., R. I.
Niles Tool Works Co., New York.
Pond Mach. Tool Co., New York.
Reed Co., F. E., Worcester, Mass.

Hack Saw Blades and Frames
Diamond Saw & Stamping Works, Buffalo, N. Y.
Goodell-Pratt Co., Greenfield, Mass.
Hammacher, Schlemmer & Co., New York.
Starrett Co., L. S., Athol, Mass.
West Haven Mfg. Co., New Haven, Conn.

Hack Saws, Power
Diamond Saw & Stamping Works, Buffalo, N. Y.
Frasse Co., New York.
Hoefer Mfg. Co., Freeport, Ill.
West Haven Mfg. Co., New Haven, Conn.

Hammers, Drop
Bement, Miles & Co., New York.
Billings & Spencer Co., Hartford, Conn.
Bliss Co., E. W., Brooklyn, N. Y.
Iroquois Machine Co., Providence, R. I.
Merrill Bros., Brooklyn, N. Y.
Mossberg & Granville Mfg. Co., Providence, R. I.
Perkins Mach. Co., Boston, Mass.
Toledo Mach. & Tool Co., Toledo, Ohio.

Hammers, Pneumatic
Chicago Pneumatic Tool Co., Chicago, Ill.
Cleveland Pneumatic Tool Co., Cleveland, O.
Dallett & Co., Thos. H., Phila., Pa.
Phila. Pneu. Tool Co., Philadelphia, Pa.
Q. & C. Co., Chicago, Ill.
Standard Ry. Equip. Co., St. Louis, Mo.

Hammers, Power
Scranton & Co. The, New Haven, Conn.

Hammers, Steam
Bement, Miles & Co., New York.
Bethlehem Fdry. & Mach. Co., So. Bethlehem, Pa.
Cleveland Punch & Shear Wks. Co., Cleveland, O.

Heating Machines, Automatic
Am. Gas Furnace Co., New York.

Heating and Ventilating Apparatus
Buffalo Forge Co., Buffalo, N. Y.

Hoisting and Conveying Machinery
Brown Hoisting Mchry. Co., New York.
Caldwell & Son Co., H. W., Chicago, Ill.
Hunt Co., C. W., West New Brighton, N. Y.
Link Belt Engineering Co., Philadelphia, Pa.
Niles-Bement-Pond Co., New York.

Hoists, Electric
C & C Electric Co., New York.
Hunt Co., C. W., West New Brighton, N. Y.
Northern Engineering Works, Detroit, Mich.
Pawling & Harnischfeger, Milwaukee, Wis.
Sprague Electric Co., New York.

Hoists, Hand
Harrington, Son & Co., Edwin, Philadelphia, Pa.
Yale & Towne Mfg. Co., New York.

Hoists, Pneumatic
Chicago Pneumatic Tool Co., Chicago, Ill.
Cleveland Pneumatic Tool Co., Cleveland, O.
Northern Engineering Wks., Detroit, Mich.
Rand Drill Co., New York.

Indicators, Speed
Starrett Co., L. S., Athol, Mass.

Indicators, Steam
Crosby Steam Gage & Valve Co., Boston, Mass.

Indicators, Test
Lowe, H. A., Waltham, Mass.

Injectors
Lunkenheimer Co., Cincinnati, O.
Sellers & Co., Wm., Phila., Pa.

Inspection and Tests
Hunt Co., Robt. W., Chicago, Ill.

Instruction Schools
See Schools, Correspondence.

Insurance, Boiler
Hartford Steam Boiler Insp. & Ins. Co., Hartford, Conn.

Jacks, Hydraulic
Bethlehem Fdry & Mch. Co., So. Bethlehem, Pa.
Watson-Stillman Co., New York.

Key Seaters
Baker Bros., Toledo, O.
Bement, Miles & Co., New York.
Chattanooga Mchry. Co., Chattanooga, Tenn.
Davis Mach. Co., W. P., Rochester, N. Y.
Mitts & Merrill, Saginaw, Mich.

Keys, Machine
Standard Gauge Steel Co., Beaver Falls, Pa.
Whitney Mfg. Co., Hartford, Ct.

Lamps, Arc
General Electric Co., N. Y. City.
Western Electric Co., Chicago, Ill.
Westinghouse Elec. & Mfg. Co., Pittsburgh, Pa.

Lathes
American Tool Wks. Co., Cin., O.
Auto. Mach. Co., Bridgeport, Ct.
Automatic Mach. Co., Greenfield, Mass.
Barnes Co., B. F., Rockford, Ill.
Barnes Co., W. F. & John, Rockford, Ill.
Bement, Miles & Co., New York.
Bradford Mach. Tool Co., Cin., O.
Bullard Mach. Tool Co., Bridgeport, Conn.
Davis Mach. Co., W. P., Rochester, N. Y.
Diamond Machine Co., Provi., R. I.
Fay & Scott, Dexter, Me.
Flather & Co., Nashua, N. H.
Frasse Co., New York.
Garvin Mach. Co., New York.
Harrington, Son & Co., Edwin, Philadelphia, Pa.
Hendey Mach. Co., Torrington, Ct.
Hill, Clarke & Co., Boston, Mass.
Le Blond Mach. Tool Co., R. K., Cincinnati, O.
Lodge & Shipley Mch. Tool Co., Cincinnati, O.
McCabe, J. J., Nw York.
Marshall & Huschart Mchry. Co., Chicago, Ill.
New Haven Mfg. Co., New Haven, Conn.
Niles Tool Works Co., New York.
Pond Mach. Tool Co., New York.
Pratt & Whitney Co., Hartford, Conn.
Prentice Bros. Co., Worcester, Mass.
Prentiss Tool & Supply Co., New York.
Reed Co., F. E., Worcester, Mass.
Schumacher & Boye, Cincinnati, Ohio.
Sebastian Lathe Co., Cincin., O.
Seneca Falls Mfg. Co., Seneca Falls, N. Y.
Tanite Co., Stroudsburg, Pa.
Washburn Shops, Worcester, Mass.

Lathes, Automatic Screw-Threading
Automatic Machine Co., Bridgeport, Conn.

Lathes, Bench
Faneuil Watch Tool Co., Boston, Mass.
Waltham Watch Tool Co., Springfield, Mass.

Lathes, Wood
American Machinery Co., Grand Rapids, Mich.

Lathe Dogs
Armstrong Bros. Tool Co., Chicago, Ill.
Besly & Co., Chas. H., Chicago, Ill.
Le Count, Wm. G., So. Norwalk, Conn.
Pratt & Whitney Co., Hartford, Conn.

Letters, Pattern
Butler, A. G., N. Y. City.

Levels
Starrett Co., L. S., Athol, Mass.

Lockers, Clothes
Merritt & Co., Philadelphia, Pa.
Narragansett Mach. Co., Providence, R. I.

Locomotives, Shop
Hunt Co., C. W., West New Brighton, N. Y.

Lubricants
Besly & Co., Chas. H., Chicago, Ill.
Dixon Crucible Co., Jos., Jersey City, N. J.
Lubriphite Co., Jersey City, N. J.

Lubricators
Besly & Co., Chas. H., Chicago, Ill.
Bowen Mfg. Co., Auburn, N. Y.
Crane Co., Chicago, Ill.
Lubriphite Co., Jersey City, N. J.
Lunkenheimer Co., Cincinnati, O.

Machine Screws
Atlantic Mach. Screw Co., Boston, Mass.
Worcester Mach. Screw Co., Worcester, Mass.

Machinery Builders, Special
American Fdry. & Mach. Co., Hanover, Pa.
Atlas Foundry & Mach. Co., Belleville, N. J.
Blanchard Mach. Co., The, Boston, Mass.
Fawcus Mch. Co., Pittsburgh, Pa.
Gardam & Son, Wm., New York.
National Mchry. Co., Tiffin, O.
Power & Speed Regulator Mfg. Co., Kalamazoo, Mich.
Pratt & Whitney Co., Hartford, Conn.
Simonds Mfg. Co., Pittsburgh, Pa.

Machinists' Small Tools
Besly & Co., Chas. H., Chicago, Ill.
Billings & Spencer Co., Hartford, Conn.
Brown & Sharpe Mfg. Co., Providence, R. I.
Cleveland Twist Drill Co., Cleveland, O.
Hammacher, Schlemmer & Co., New York.
McCrosky & Huber, Cincinnati, O.
Patterson, Gottfried & Hunter, Ltd., New York.
Sawyer Tool Mfg. Co., Fitchburg, Mass.
Slocomb & Co., J. T., Provi., R. I.
Starrett Co., L. S., Athol, Mass.
Wyke & Co., J., East Boston, Mass.

Mandrels, Expanding
Nicholson & Son, W. H., Wilkesbarre, Pa.

Mandrels, Solid
Cleveland Twist Drill Co., Cleveland, O.
Morse Twist Drill & Mach. Co., New Bedford, Mass.
Rogers, John M., Boat, Gage & Drill Works, Gloucester City, N. J.
Standard Tool Co., Cleveland, O.

Measuring Machines
Rogers, John M., Boat, Gage & Drill Works, Gloucester City, N. J.

Micrometer Calipers
Brown & Sharpe Mfg. Co., Providence, R. I.
Sawyer Tool Mfg. Co., Fitchburg, Mass.
Slocomb & Co., J. T., Providence, R. I.
Starrett Co., L. S., Athol, Mass.

Milling Attachments
The Adams Co., Dubuque, Iowa.
Brown & Sharpe Mfg. Co., Providence, R. I.
Cincinnati Milling Mach. Co., Cincinnati, O.
Kempsmith Mfg. Co., Milwaukee, Wis.
Oesterlein Mach. Co., Cincin., O.

Milling Machines, Bench
Faneuil Watch Tool Co., Boston, Mass.
Hill, Clarke & Co., Boston, Mass.
Waltham Watch Tool Co., Springfield, Mass.

Milling Machines, Horizontal
Adams Co., Dubuque, Iowa.
Beaman & Smith Co., Prov., R. I.
Bement, Miles & Co., New York.
Franklin Mach. Wks., Phila., Pa.
Hendey Mach. Co., Torrington, Ct.
Ingersoll Mill. Mach. Co., Rockford, Ill.
Newton Mach. Tool Wks., Philadelphia, Pa.
Niles Tool Works Co., New York.
Pratt & Whitney Co., Hartford, Conn.

Milling Machines, Plain
American Tool Wks. Co., Cin., O.
Bement, Miles & Co., New York.
Brown & Sharpe Mfg. Co., Providence, R. I.
Cincinnati Milling Mach. Co., Cincinnati, O.
Garvin Mach. Co., New York.
Hendey Mach. Co., Torrington, Ct.
Hill, Clarke & Co., Boston, Mass.
Kempsmith Mfg. Co., Milwaukee, Wis.
Le Blond Mach. Tool Co., R. K., Cincinnati, O.
Marshall & Huschart Mchry Co., Chicago, Ill.
McCabe, J. J., New York.
Oesterlein Mach. Co., Cincin., O.
Owen Mach. Tool Co., Springfield, Ohio.
Prentiss Tool & Supply Co., New York.
Whitney Mfg. Co., Hartford, Ct.

Milling Machines, Portable
Underwood & Co., H. B., Philadelphia, Pa.

Milling Machines, Universal
American Tool Wks. Co., Cin., O.
Bement, Miles & Co., New York.
Brown & Sharpe Mfg. Co., Providence, R. I.
Cincinnati Milling Mach. Co., Cincinnati, O.
Garvin Mach. Co., New York.
Hendey Mach. Co., Torrington, Ct.
Hill, Clarke & Co., Boston, Mass.
Kempsmith Mfg. Co., Milwaukee, Wis.
Le Blond Mach. Tool Co., R. K., Cincinnati, O.
Marshall & Huschart Mchry. Co., Chicago, Ill.
McCabe, J. J., New York.
Niles Tool Works Co., New York.
Oesterlein Mach. Co., Cincin., O.
Owen Mach. Tool Co., Springfield, Ohio.
Prentiss Tool & Supply Co., New York.
Waltham Watch Tool Co., Springfield, Mass.

Milling Machines, Vertical
Bement, Miles & Co., New York.
Brown & Sharpe Mfg. Co., Providence, R. I.
Garvin Mach. Co., New York.
Ingersoll Mill. Mach. Co., Rockford, Ill.
Newton Mch. Tool Works, Philadelphia, Pa.
Niles Tool Works Co., New York.
Owen Mach. Tool Co., Springfield, Ohio.
Pratt & Whitney Co., Hartford, Conn.

Milling Tools, Adjustable
Geometric Drill Co., New Haven, Conn.
Rogers, Boat, Gage & Drill Wks., John M., Gloucester City, N. J.

Molding Machines
The Adams Co., Dubuque, Iowa.
American Foundry & Mach. Co., Hanover, Pa.
Tabor Mfg. Co., Philadelphia, Pa.
Webster & Perks Tool Co., Springfield, O.

Molds, Hammer and Vise Jaw
Field, Chas. H., Providence, R. I.

Motors, Electric
Akron Elec. Mfg. Co., Akron, O.
C & C Electric Co., New York.
Christensen Engr. Co., Milwaukee, Wis.
Crocker-Wheeler Co., Ampere, N. J.
Eck Dynamo & Motor Wks., Belleville, N. J.
General Electric Co., New York.
Jantz & Leist Elec. Co., Cin., O.
Mechanical Appliance Co., Milwaukee, Wis.
Northern Elec. Mfg. Co., Madison, Wis.
Robbins & Myers Co., Springfield, Ohio.
Sprague Electric Co., New York.
Triumph Elec. Co., Cincinnati, O.
Western Electric Co., Chicago, Ill.
Westinghouse Elec. & Mfg. Co., Pittsburgh, Pa.

Nail Machinery, Wire
National Machy. Co., Tiffin, O.

Name Plates
Franklin Mfg. Co., Syracuse, N. Y.

Nut Tappers
See Bolt and Nut Machinery.

Oils
Besly & Co., Chas. H., Chicago, Ill.
Houghton & Co., E. F., Philadelphia, Pa.

Oil Cups and Covers
Bay State Stamping Works, Worcester, Mass.
Besly & Co., Chas. H., Chicago, Ill.
Bowen Mfg. Co., Auburn, N. Y.
Crane Co., Chicago, Ill.
Lunkenheimer Co., Cincinnati, O.
The Winkley Co., Hartford, Conn.

Packing, Steam Joint
Jenkins Bros., New York.

Pans, Lathe
New Britain Mch. Co., New Britain, Conn.

Pans, Shop
Kilbourne & Jacobs Mfg. Co., Columbus, O.

Patents
Baldwin, Davidson & Wight, Washington, D. C.

Pattern Shop Machinery
American Machinery Co., Grand Rapids, Mich.
Baker Bros., Toledo, O.
Fay & Scott, Dexter, Me.
Field, Chas. H., Providence, R. I.
Prentiss Tool & Supply Co., New York.
Washburn Shops, Worcester, Mass.

Patterns, Wood
Gobeille Pattern Co., Cleveland, O.
Lorentz & Evarts, Hartford, Conn.

Pencils
Keuffel & Esser Co., New York.

Pipe and Fittings
Crane Co., Chicago, Ill.

Pipe Cutting and Threading Machines
Curtis & Curtis Co., Bridgeport, Conn.
Merrell Mfg. Co., Toledo, O.
Oster Mfg. Co., Cleveland, O.
Saunders' Sons, D., Yonkers, N. Y.
Wells Bros. Co., Greenfield, Mass.

Pipe Fitters' Tools
Cleveland Twist Drill Co., Cleveland, O.
Saunders' Sons, D., Yonkers, N. Y.
Standard Tool Co., Cleveland, O.

Planer, Jack
Armstrong Bros. Tool Co., Chicago, Ill.

Planers
American Tool Wks. Co., Cin., O.
Betmer Mach. Tool Co., Cin., O.
Bement, Miles & Co., New York.
Betts Mach. Co., Wilmington, Del.
Cincinnati Planer Co., Cincin., O.
Detrick & Harvey Mch. Co., Baltimore, Md.
Flather Planer Co., Mark, Nashua, N. H.
Garvin Mach. Co., New York.
Gray Co., G. A., Cincinnati, O.
Harrington, Son & Co., Edwin, Philadelphia, Pa.
Hendey Mach. Co., Torrington, Ct.
Hill, Clarke & Co., Boston, Mass.
McCabe, J. J., New York.
Niles Tool Works Co., New York.
New Haven Mfg. Co., New Haven, Conn.
Pond Mach. Tool Co., New York.
Prentiss Tool & Supply Co., New York.
Sellers & Co., Wm., Phila., Pa.
Whitcomb Mfg. Co., Worcester, Mass.
Woodward & Powell Planer Co., Worcester, Mass.

Planers, Bench
Bartlett, E. E., Boston, Mass.

Planers, Rotary
Bement, Miles & Co., New York.
Cleveland Punch & Shear Works, Cleveland, O.
Franklin Mach. Wks., Phila., Pa.
Newton Mach. Tool Wks., Philadelphia, Pa.
Pond Mach. Tool Co., New York.

Presses, Hydraulic
Bement, Miles & Co., New York.
Watson-Stillman Co., New York.

Presses, Hand
Elmes Engr. Wks., Chas. F., Chicago, Ill.

Presses, Power
Automatic Mach. Co., Bridgeport, Conn.
Bethlehem Fdry. & Mch. Co., So. Bethlehem, Pa.
Bliss Co., E. W., Brooklyn, N. Y.
Dill Mach. Co., T. C., Phila., Pa.
Mossberg & Granville Mfg. Co., Providence, R. I.
Perkins Mach. Co., Boston, Mass.
Prentiss Tool & Supply Co., New York.
Toledo Machine & Tool Co., Toledo, O.
Wold & Co., Torris, Chicago, Ill.

Profilers
Garvin Mach. Co., New York.
Pratt & Whitney Co., Hartford, Conn.

Pulley Turning and Boring Machines
American Tool Wks. Co., Cin., O.
Harrington, Son & Co., Edwin, Philadelphia, Pa.
New Haven Mfg. Co., New Haven, Conn.
Niles Tool Works Co., New York.

Pulleys, Friction Cone
Evans Friction Cone Co., Boston, Mass.

Pulleys
Caldwell & Son Co., H. W., Chicago, Ill.
Cresson Co., Geo. V., Phila., Pa.
Howard Iron Wks., Buffalo, N. Y.
Poole & Son Co., Robt., Baltimore, Md.
Reeves Pulley Co., Columbus, Ind.
Saunders Mfg. Co., Dayton, O.

Pulleys, Speed Changing
Speed Changing Pulley Co., Indianapolis, Ind.

Pumps, Hydraulic
Watson-Stillman Co., New York.

Punches, Hydraulic
Bement, Miles & Co., New York.
Bethlehem Fdry. & Mch. Co., So. Bethlehem, Pa.
Watson-Stillman Co., New York.

Punches, Power
Bliss Co., E. W., Brooklyn, N. Y.
Bremer Mach. & Tool Co., Kalamazoo, Mich.
Buffalo Forge Co., Buffalo, N. Y.
Cincinnati Punch & Shear Co., Cincinnati, O.
Cleveland Punch & Shear Wks., Cleveland, O.
Hilles & Jones Co., Wilmington, Del.
Long & Allstatter Co., Hamilton, Ohio.
Perkins Mach. Co., So. Boston, Mass.
Reade Mchry Co., Cleveland, O.

Rack Cutting Machines
Fellows Gear Shaper Co., Springfield, Vt.
Le Blond Mach. Tool Co., R. K., Cincinnati, O.
Reed Co., F. E., Worcester, Mass.

Racks, Cut
Fellows Gear Shaper Co., Springfield, Vt.
Nuttall Co., R. D., Pittsburgh, Pa.
Simonds Mfg. Co., Pittsburgh, Pa.
Standard Gauge Steel Co., Beaver Falls, Pa.

Racks, Tool
New Britain Mach. Co., New Britain, Conn.

Reamers
Cleveland Twist Drill Co., Cleveland, O.
Clough, R. M., Tolland, Conn.
McCrosky & Huber, Cincinnati, O.
Morse Twist Drill & Mach. Co., New Bedford, Mass.
Pratt & Whitney Co., Hartford, Conn.
Rogers, John M., Boat, Gage & Drill Works, Gloucester City, N. J.
Standard Tool Co., Cleveland, O.
Wells Bros. Co., Greenfield, Mass.

Reaming Stands
Flather Planer Co., Mark, Nashua, N. H.

Riveters, Hydraulic
Bement, Miles & Co., New York.
Watson-Stillman Co., New York.

Riveters, Pneumatic
Bement, Miles & Co., New York.
Cleveland Pneumatic Tool Co., Cleveland, O.
Philadelphia Pneumatic Tool Co., Philadelphia, Pa.
Q & C Co., Chicago, Ill.
Standard Ry. Equip. Co., St. Louis, Mo.

Riveting Machines
Bement, Miles & Co., New York.
Bethlehem Foundry & Mach. Co., So. Bethlehem, Pa.
Long & Allstatter Co., Hamilton, Ohio.
Perkins Mach. Co., So. Boston, Mass.

Rods and Straps, Connecting
Standard Connecting Rod Co., Beaver Falls, Pa.

Rolling Mill Machinery
Cleveland Punch & Shear Wks. Co., Cleveland, O.
Diamond Drill & Mch. Co., Birdsboro, Pa.
Dill Mach. Co., T. C., Phila., Pa.
Hilles & Jones Co., Wilmington, Del.
Iroquois Mach. Co., Providence, R. I.
Mossberg & Granville Mfg. Co., Providence, R. I.
Pratt & Whitney Co., Hartford, Conn.

Roller and Ball Bearings
Ball Bearing Co., Philadel., Pa.
Iroquois Mach. Co., Providence, R. I.
Mossberg & Granville Mfg. Co., Providence, R. I.

Rolls, Bending
Cincinnati Punch & Shear Co., Cincinnati, O.
Hilles & Jones Co., Wilmington, Del.
Perkins Mach. Co., So. Boston, Mass.

Safety Valves, Pop
Crane Co., Chicago, Ill.
Crosby Steam Gage & Valve Co., Boston, Mass.
Lunkenheimer Co., Cincinnati, O.

Sawing Machines, Metal
Cleveland Punch & Shear Works Co., Cleveland, O.
Cochrane-Bly Mach. Works, Rochester, N. Y.
Newton Mach. Tool Works, Philadelphia, Pa.
Pratt & Whitney Co., Hartford, Conn.
Reade Mchry. Co., Cleveland, O.

Sawing Machines, Wood
American Machinery Co., Grand Rapids, Mich.

Schools, Correspondence
Amer. School of Correspondence, Boston, Mass.
Consolidated Schools, N. Y. City.
International Correspond. Schools, Scranton, Pa.

Screw Machines, Automatic
Brown & Sharpe Mfg. Co., Providence, R. I.
Cleveland Automatic Mach. Co., Cleveland, Ohio.
Dreses Mach. Tool Co., Cincin., O.
Marshall & Huschart Mchry. Co., Chicago, Ill.
Windsor Mach. Co., Windsor, Vt.

Screw Machines, Hand
Brown & Sharpe Mfg. Co., Providence, R. I.
Cleveland Automatic Mach. Co., Cleveland, O.
Garvin Mach. Co., New York.
Jones & Lamson Mch. Co., Springfield, Vt.
Pearson Mach. Co., Chicago, Ill.
Potter & Johnston Mach. Co., Pawtucket, R. I.
Pratt & Whitney Co., Hartford, Conn.
Warner & Swasey Co., Cleveland, Ohio.
Windsor Mach. Co., Windsor, Vt.

Screw Machinery, Wood and Lag
Baker Bros., Toledo, Ohio.
Cook Co., Asa S., Hartford, Conn.

Screw Plates
Besly & Co., Chas. H., Chicago, Ill.
Carpenter Tap & Die Co., J. M., Pawtucket, R. I.
Card Mfg. Co., S. W., Mansfield, Mass.
Hart Mfg. Co., Cleveland, O.
Morse Twist Drill & Mach. Co., New Bedford, Mass.
Oster Mfg. Co., Cleveland, O.
Wells Bros. Co., Greenfield, Mass.
Wiley & Russell Mfg. Co., Greenfield, Mass.

Second Hand Machinery
Affleck, Geo. E., New York.
Baird Machy. Co., Pittsburgh, Pa. Pa.
Bowler & Co., Geo. H., Cleveland, Ohio.
Carlin Mchry. & Supply Co., Allegheny, Pa.
Dawson, John H., Chicago, Ill.
Fairbanks Co., Philadelphia, Pa.
Garvin Mch. Co., New York.
Hill, Clarke & Co., Boston, Mass.
Marshall & Huschart Mchry. Co., Chicago, Ill.
Marshall & Huschart Mchry. Co., Cleveland, O.
McCabe, J. J., New York.
Niles Tool Works Co., New York.
Pratt & Whitney Co., Hartford, Conn.
Prentiss Tool & Supply Co., New York.
Toomey, Frank, Philadelphia, Pa.
Wormer Machy. Co., C. C., Detroit, Mich.

Separators, Oil
American Tool & Mach. Co., Boston, Mass.

Shafts, Crank
Standard Connecting Rod Co., Beaver Falls, Pa.

Shapers
American Tool Wks. Co., Cin. O.
Bement, Miles & Co., New York.
Cincinnati Shaper Co., Cincin., O.
Flather Planer Co., Mark, Nashua, N. H.
Garvin Mach. Co., New York.
Hendey Mch. Co., Torrington, Ct.
Gould & Eberhardt, Newark, N. J.
Hill, Clarke & Co., Boston, Mass.
Kelly Co., R. A., Xenia, Ohio.
Marshall & Huschart Mchry. Co., Chicago, Ill.
New Haven Mfg. Co., New Haven. Conn.
Niles Tool Works Co., New York.
Perkins Mach. Co., Boston. Mass.
Potter & Johnston Mach. Co., Pawtucket, R. I.
Steptoe & Co., John, Cincinnati, O.

Shears, Power
Bethlehem Fdry. & Mch. Co., So. Bethlehem, Pa.
Bliss Co., E. W., Brooklyn, N. Y.
Bremer Mach. & Tool Co., Kalamazoo, Mich.
Buffalo Forge Co., Buffalo, N. Y.
Cincinnati Punch & Shear Co., Cincinnati, O.
Cleveland Punch & Shear Works. Cleveland, O.
Hilles & Jones Co., Wilmington, Del.
Long & Allstatter Co., Hamilton, Ohio.
National Mchry. Co., Tiffin, O.
Perkins Mach. Co., Boston, Mass.
Reade Mchry Co., Cleveland, O.
Toledo Mach. & Tool Co., Toledo, Ohio.

Shears, Rotary
Bethlehem Foundry & Mach. Co., So. Bethlehem, Pa.
Detrick & Harvey Mach. Co., Baltimore, Md.
Perkins Mach. Co., So. Boston, Mass.

Shelving, Shop
New Britain Mach. Co., New Britain, Conn.

Slide Rests
Bartlett, E. E., Boston, Mass.
Reed Co., F. E., Worcester, Mass.

Slotters
Baker Bros., Toledo, Ohio.
Bement, Miles & Co., New York.
Betts Mach. Wks., Wilmington, Del.
Dill Mach. Co., T. C. Phila., Pa.
Franklin Mach. Wks., Phila., Pa.
Garvin Mach. Co., New York.
New Haven Mfg. Co., New Haven, Conn.
Newton Mach. Tool Wks., Philadelphia, Pa.
Niles Tool Works Co., New York.

Spike Machines
National Machy. Co., Tiffin, O.

Sprocket Chains
See Driving Chains.

Stampings, Sheet Steel
Federal Mfg. Co., Cleveland, O.

Stamps, Steel
The Chandler Co., Springfield, Mass.
Schwerdtle Stamp Co., Bridgeport, Conn.

Steel, Machinery
Boker & Co., Hermann, New York.
Patriarche & Bell, New York.
Ward & Son, Edgar T., Boston, Mass.

Steel, Sheet
Federal Mfg. Co., Cleveland, O.
Ward & Son, Edgar T., Boston, Mass.

Steel, Tool
Boker & Co., Hermann, New York.
Patriarche & Bell, New York.

Straightener, Hydraulic
Bement, Miles & Co., New York.
Watson-Stillman Co., New York.

Swaging Machines
Excelsior Needle Co., Torrington, Conn.
Iroquois Mach. Co., Provi., R. I.
Mossberg & Granville Mfg. Co., Providence, R. I.

Switchboards
C & C Electric Co., New York.
Electric Controller & Supply Co., Cleveland, O.
Triumph Elec. Co., Cincinnati, O.
Western Electric Co., Chicago, Ill.

Tapping Machines and Attachments
Baker Bros., Toledo, O.
The Beaman & Smith Co., Providence, R. I.
Bickford Drill & Tool Co., Cin., O.
Cincinnati Mach. Tool Co., Cincinnati, O.
Errington, F. A., N. Y. City.
Fosdick Mach. Tool Co., Cin., O.
Garvin Mach. Co., New York.
Geometric Drill Co., New Haven, Conn.
National Mchry. Co., Tiffin, O.
Pratt & Whitney Co., Hartford, Conn.
Seneca Falls Mfg. Co., Seneca Falls, N. Y.
Webster & Perks Tool Co., Springfield, O.

Taps, Collapsing
Geometric Drill Co., New Haven, Conn.

Taps and Dies
Besly & Co., Chas. H., Chicago, Ill.
Card Mfg. Co., S. W., Mansfield, Mass.
Carpenter Tap & Die Co., J. M., Pawtucket, R. I.
Cleveland Twist Drill Co., Cleveland, O.
Crane Co., Chicago, Ill.
Hammacher, Schlemmer & Co., New York.
Hart Mfg. Co., Cleveland, O.
Morse Twist Drill & Mach. Co., New Bedford, Mass.
National Mchry. Co., Tiffin, O.
Oster Mfg. Co., Cleveland, O.
Pratt & Whitney Co., Hartford, Conn.
Standard Tool Co., Cleveland, O.
Webster & Perks Tool Co., Springfield, O.
Wells Bros. Co., Greenfield, Mass.
Wiley & Russell Mfg. Co., Greenfield, Mass.

Telephone System
Clarke Auto. Telephone Switch Board Co., Providence, R. I.

Thread Cutting Tools
Besly & Co., Chas. H., Chicago, Ill.
Hart Mfg. Co., Cleveland, O.
Oster Mfg. Co., Cleveland, O.
Pratt & Whitney Co., Hartford, Conn.
Rivett-Dock Co., Boston, Mass.

Tool Holders
Armstrong Bros. Tool Co., Chicago, Ill.
Hoggson & Pettis Mfg. Co., New Haven, Conn.
McCrosky & Huber, Cincinnati, O.
Western Mfg. Co., Springfield, O.

Tools
See Machinists' Small Tools.

Transmission Machinery
Caldwell & Son Co., H. W., Chicago, Ill.
Cresson & Co., Geo. V., Phila., Pa.
Link-Belt Engineering Co., Philadelphia, Pa.
Patterson, Gottfried & Hunter, Ltd., New York.
Power & Speed Regulator Mfg. Co., Kalamazoo, Mich.
Reeves Pulley Co., Columbus, Ind.
Saunders Mfg. Co., Dayton, O.

Traps, Steam
Houghton & Co., E. F., Philadelphia, Pa.

Trimmers, Wood
Amer. Mchry. Co., Grand Rapids, Mich.
Washburn Shops, Worcester, Mass.

Trolleys and Tramways
Brown Hoisting Machy. Co., N. Y. City.
Harrington, Son & Co., Edwin, Philadelphia, Pa.
Hunt Co., C. W., West New Brighton, N. Y.
Link Belt Engineering Co., Philadelphia, Pa.
Maris Bros., Philadelphia, Pa.
Yale & Towne Mfg. Co., New York.

Turrets, Carriage
Fay & Scott, Dexter, Me.

Turret Machines
American Tool & Mach. Co., Boston, Mass.
Automatic Mach. Co., Greenfield, Mass.
Bradford Mach. Tool Co., Cincinnati, O.
Brown & Sharpe Mfg. Co., Providence, R. I.
Bullard Mach. Tool Co., Bridgeport, Conn.
Dreses Mach. Tool Co., Cincin., O.
Flather & Co., Nashua, N. H.
Foster, Walter H., New York.
Garvin Mach. Co., New York.
Gisholt Mch. Co., Madison, Wis.
Hill, Clarke & Co., Boston, Mass.
Jones & Lamson Mch. Co., Springfield, Vt.
Le Blond Mach. Tool Co., R. K., Cincinnati, O.
Lodge & Shipley Mach. Tool Co., Cincinnati, O.
Niles Tool Works Co., New York.
Pearson Mach. Co., Chicago, Ill.
Potter & Johnston Mach. Co., Pawtucket, R. I.
Warner & Swasey Co., Cleveland, Ohio.
Windsor Mach. Co., Windsor, Vt.

Twist Drills
Cleveland Twist Drill Co., Cleveland, O.
Etna Mfg. Co., New York.
Hammacher, Schlemmer & Co., New York.
Morse Twist Drill & M. Co., New Bedford, Mass.
Standard Tool Co., Cleveland, O.

Universal Joints
Baush Machine Tool Co., Springfield, Mass.
Vanderbeek Tool Works, Hartford, Conn.

Valves
See Steam Fittings.

Vises, Drill
Graham Mfg. Co., Provi., R. I.
Jacobson Mach. Mfg. Co., Warren, Pa.

Vises, Metal Workers'
Hammacher, Schlemmer & Co., New York.
Howard Iron Wks., Buffalo, N. Y.
Jacobson Mach. Mfg. Co., Warren, Pa.
Parker Co., Chas., Meriden, Conn.
Prentiss Vise Co., New York.
Vanderbeek Tool Works, Hartford, Conn.
Walworth Mfg. Co., Boston, Mass.

Vises, Pipe
Curtis & Curtis Co., Bridgeport, Conn.
Prentiss Vise Co., New York.
Saunders' Sons, D., Yonkers, N. Y.
Walworth Mfg. Co., Boston, Mass.

Vises, Planer and Shaper
Cincinnati Planer Co., Cincin., O.
Hendey Mach. Co., Torrington, Ct.
Pratt & Whitney Co., Hartford, Conn.

Vises, Wood Workers'
Hammacher, Schlemmer & Co., New York.
Wyman & Gordon, Worcester, Mass.

Washer Machines
National Machy. Co., Tiffin, O.

Welding Machines
Long & Allstatter Co., Hamilton, Ohio.

Wire-Drawing Machinery
Iroquois Mach. Co., Provi., R. I.
Mossberg & Granville Mfg. Co., Providence, R. I.

Wire-Forming Machinery
Automatic Mach. Co., Bridgeport, Conn.

Wood Working Machinery
American Machinery Co., Grand Rapids, Mich.

Worm Hobbing Machines
Pratt & Whitney Co., Hartford, Conn.

Worm Milling Machines
Cleveland Automatic Mach. Co., Cleveland, O.
Pratt & Whitney Co., Hartford, Conn.

Wrenches
Coes Wrench Co., Worcester, Mass.

Wrenches, Drop Forged
Billings & Spencer Co., Hartford, Conn.

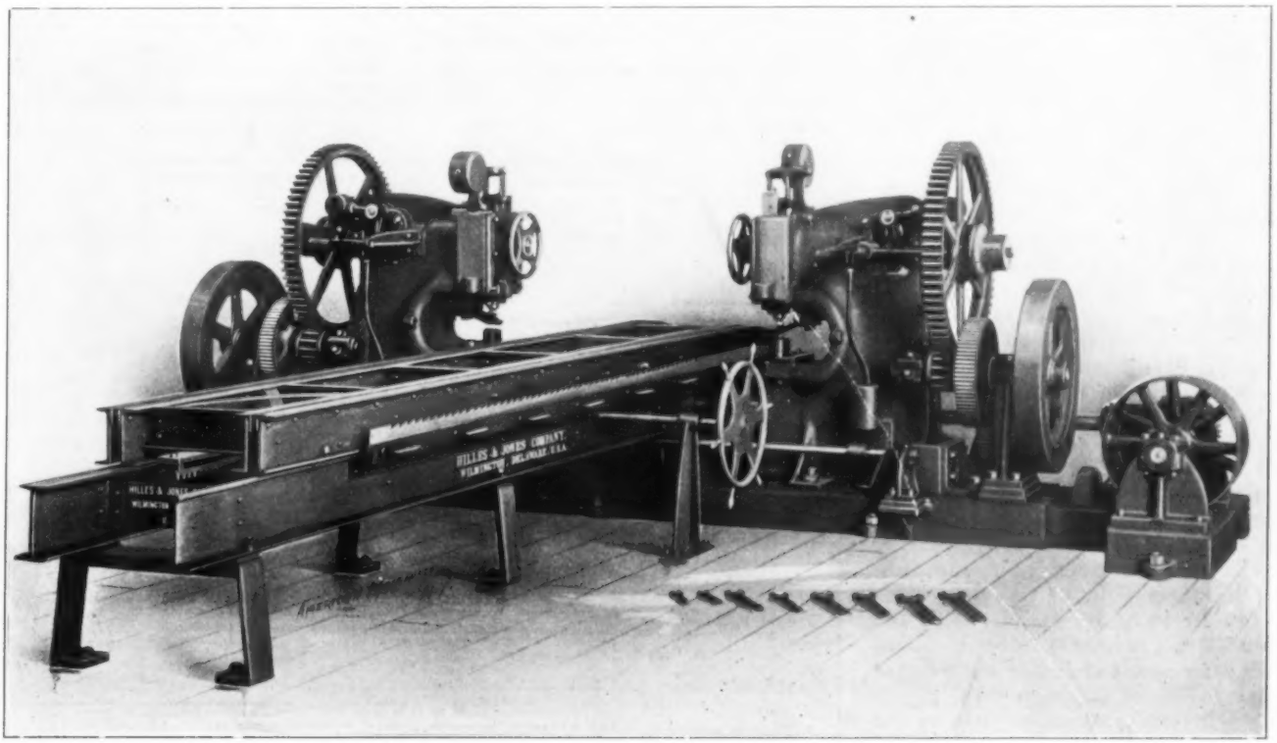
Duplex Punching Machine.

The accompanying half-tone shows a duplex punching machine built by the Hilles & Jones Company, of Wilmington, Del.

This machine, as will be seen, consists of two punch presses adjustably mounted on a heavy bed plate and driven by one shaft; thus two holes—one at each side of the plate—are punched simultaneously. The shaft is located at the rear of the machine and driven through bevel gears from the tight and loose pulleys shown at the right. The presses are adjusted on the bed by means of a screw and hand-wheel, and may be set with the centers of the punches from 3 to 6 feet apart.

The table, on which the work rests, is operated by rack and pinion—the pinion shaft being turned by the pilot wheel shown in front of the right-hand machine—and a rack and pawl are provided for obtaining the desired distance between the centers of the punched holes.

The machines can be made of any capacity or depth of throat; the one illustrated has a throat depth of 12 inches and will punch holes 1 inch in diameter through 7/8-inch plate.



DUPLEX PUNCHING MACHINE.

Perpetual Motion.

BY W. H. BOOTH.

Perpetual motion is still sought for. Some of us believe its attainment impossible, and we cannot understand the mental attitude of men who still do believe in its attainment. A mode of securing perpetual motion was brought to my notice recently, which seemed to have elements of novelty.

Suppose a balanced beam on one end of which is a weight; on the other end is hung a small fine-bored tube. Having got the device into perfect balance, raise a vessel of water until the water just touches the lower end of the tube. The water will rise up the capillary tube, which will become heavier and fall, raising the weight at the other end of the balance. Now it only remains to hang a lot of capillary tubes round a wheel for rotation to be continuous, provided that the capillary tubes can be persuaded to drop their load of water. *Provided!!* Yes, there's the rub. The problem had therefore to be attacked in another direction, adhering to the principle. The object was to get rid of the capillarity at a proper moment.

Take two smooth disks of glass and place them to revolve upon two spindles very slightly out of line. Then one edge of the disks will be nearly in contact, while the other edge will be some distance apart. Place the apparatus in water—so that the water touches the lower edge of the disks. Capillarity will enable the water to rise between the disks on the one side and it will not rise on the other side. The capillary side will therefore be constantly loaded with climbing water and this water virtually hauls down that side of the disks and this goes on forever so that if the disks are on nearly frictionless axles rotation will be continuous. It is all perfectly obvious and beyond contradiction because capillarity is the outcome of a natural law and here at least there is no attempt to circumvent nature, no juggling with levers or any such exploded nonsense. Thus perpetual motion is at last discovered. It is so obvious that there is really no occasion to make a model to prove it, as the proposition is so self-evident that it only needs to be explained to man with the money for an instant sale to be effected. This is all very good and sound, but engineers still remain unbelievers. We know it will fail to move even if we cannot exactly explain why.

I have two explanations to offer, both or either of which may be correct; and if neither of them is correct, what is the true explanation? for there must be an explanation to account for the non-rotation of so sound a device. That it will not revolve is certain. We don't need to try it, because we are absolutely sure that perpetual motion is impossible. My own attempt to explain the failure is, first, that though the capillary rise on the open side is less than that on the closer side, the width being greater there is a greater mass of water per unit of hight, and the thick mass balances the thin mass of greater area. Secondly, as the disks revolve and the imprisoned water approaches the wider space, the cohesion or adhesion of the water has to be overcome and the effort to overcome this effect or water tension is just sufficient to balance the effort of gravity to haul down the film on the close side.

The fallacy in these inventions lies in the neglect to take all the facts into the equation. The inventor tumbles across the idea of capillarity and overlooks that of surface tension. The attempt to find a *perpetuum mobile* is not wasted.

It requires thought and study to scheme

out the machine, and then, having schemed it out and knowing it must fail, it is instructive to find in what various ways Nature steps in and thwarts us. Thus a good deal may be learned and ideas of value thrust unexpectedly on us. But we may feel pretty sure of one thing: we shall not tumble on perpetual motion in all our researches, though we may, if possible, become more than ever fixed in our faith as to its unattainableness. I have met men with a faith in the possibility of discovering the secret that would almost move mountains. Sometimes I think they really do believe in it; sometimes I wonder if they really do believe.

A System of Changing Drawings and Recording the Changes.

BY S. A. WORCESTER.

The scheme which is here outlined is useful for works building machines in small lots, say, six to thirty-six machines, and making frequent changes or improvements in the machine. While saving the expense of new tracings for every minor change in the machine, it gives a complete record of every change and provides correct means of duplicating parts for repairs at any time. I evolved the system while superintendent of an Ohio engine shop employing something over 100 men and having but a small force of draftsmen. The essential feature of the plan is the Drawing Record, a book ruled like the Instruction Page here shown and in which a complete record of all changes is kept. This page and the tracings A1, A2 and A3 and the labeled prints B1, B2 and B3 were bound next to the fly-leaf of the book, showing clearly the method of using the record. The scheme also includes a rubber stamp using drawing ink for making the title corner of the tracing, a rubber numbering stamp for use in Record and on labels and tracings, a rubber stamp for each department and printed and gummed labels for use on blueprints. The sample tracing A1 shows an original drawing and the print B1 shows the label attached, with department and drawing number stamped and title penned, ready to send to the shop. Tracing A2 shows a drawing which has been altered once. All dimensions which have been changed are black spotted and lettered, as shown, and the old and new dimensions written carefully in the record of the new number, and the new figures are written in ink, as shown, on the print, and the letters, which might lead to uncertainty, are blue-pencilled out. The print is now just as definite to the workman as the print from the original number was, and the drafting room has a record of the original condition of the drawing. All altered dimensions for future prints of either original or new number must now be found from the record. Tracing A3 shows a drawing which has been changed five times, including changes of dimension, outline, material and pattern number. For a complete print of 9175 we get from the record of this number the dimensions *to* which *E* and *F* were changed and write them on the print. We then find from the records of its new numbers, 9180 and 9207, the dimensions or other details *from* which the items lettered *G*, *H*, etc., were changed later, and write these dimensions or details on the print. Then in records of the former numbers 5 70, 1022 and 205 we find the changes having the earlier letters and pen them on the print. We then blue-pencil out the letters indicating these alterations, write or print the title with pen on a gummed label and stamp the drawing number and the department and stick the label over the title of the print. Now, although the tracing shows six drawing numbers and a number of letters useless to the workman in place of dimensions and two different sets of lines and a number of blank spots in place of dimensions or pattern number, yet the labeled print has but one drawing number, and all the blanks are fille in ink and all unnecessary outlines and letters blue-pencilled out. When the number stamp is set for the tracing, it is also used to mark the new number in the Record and through all records of the former numbers, so that the record of any drawing number always shows all numbers that have been given to that drawing before or since that number. When the outlines of a piece are changed, the old lines remain on the tracing and the new ones are added. The old lines to be changed are marked in a sufficient number of places with one letter and the new lines are marked similarly with another letter. The record of the change will then be "Lines *L L* changed to *M M*." Pains are taken to see that all lines not corresponding to the record of the number desired are blue-pencilled out of the print and all of the letters indicating the changes either of outline or dimension, are carefully pencilled out.

In issuing the order for building a lot of engines, a complete list of drawing numbers was given, a duplicate to each department needing it and the test record of each engine also showed a complete list of the drawing numbers from which it was built. Before the adoption of this new drawing record and number system, it was a frequent occurrence for part of a lot of engines to be made and the drawings then altered and the rest of the lot built to the changed drawings. There was then no correct record of the first engines, and when an order came some months or years later for a repair part for one of them the repair would be supplied by the drawing unless someone happened to remember the change, and an annoying misfit would be the result, causing delay and expense and perhaps loss of customers. The new scheme avoided these troubles by giving a complete record at small expense.

Always record all Former Nos. and add New Nos. as made.

Form 131.

INSTRUCTION PAGE
RECORD OF DRAWINGS

See Instruction Page in front for full directions for entries.

No.	Date.	TITLE OF DRAWING AND CHANGES MADE.	Former Nos.	New Nos.
9173	6-7-1901	Governor—20 x 40 Engine. This entry shows an original drawing with its original No. (9173). The drawing has not been changed in any way. The day, month and year must be entered in date column.		
9174	6-7-1901	Crank Pin—18 x 36 Engine. A Changed from 5½" to 6". B Changed from 4" to 4½". This entry shows that drawing No. 760 was changed on this date to this No. (9174) by the changes here entered. (See tracings and prints opposite this page.) Former Numbers are to be entered beginning at foot of Former No. column. The Dimension, Outline or Pattern No., *from* which and *to* which the drawing is changed, must be entered by letter as here shown.	760	
9175	6-8-1901	Sub Base & Pin—18 x 36 Engine. E Changed from 10½" to 11". F changed from 9" to 9½". This entry shows that drawing No. 205 was changed successively to Nos. 1022, 5070, 9175, 9185 and 9207. The above written items are the changes made when the No. was changed from No. 5070 to this No. (9175). The New Nos. (9185 and 9207) refer to later changes which are entered in proper order in the records of these numbers.	5070 1022 205	9185 9207

RULES.

I. Whenever a dimension, outline, pattern number or other feature of a drawing is so changed that the part so modified will not interchange with one made from the drawing in its former state, the drawing must be given a new number.
II. Patterns changed so as not to interchange with previous work, must be given new numbers.
III. Pattern numbers, names of parts and material of which they are made must appear on drawings.
IV. Drawing numbers must be stamped, not written, in Record and on tracings and prints.

Steinlen and His Methods.

Each year the Society for the Promotion of National Industry, in France, upon the recommendation of one of its committees, awards a grand gold medal to some inventor who has wrought a work

exerting the greatest influence on the industry of the nation. This year the Committee of Mechanical Arts, to whom fell the selection of someone, native or foreign, for the purpose, awarded the Prony medal to V. Steinlen, a veteran designer and manufacturer of machinery, particularly of machine tools. In the name of the committee, Ed. Sauvage, a well-known figure in French mechanical literature, presented a report in which he discussed the work of M. Steinlen and the principles of high-grade tool building illustrated in his work. Some of M. Sauvage's remarks were, in substance, as follows:

"In his study of mechanisms Steinlen constantly applied the excellent principle of keeping always in sight not only the effect desired to be produced by a machine, but also the ease and simplicity of its manufacture with the means at hand. In his own words: 'Since I have been in the industry (that is to say, since 1841) I have always sought for what was simple, natural . . . and especially that which could easily be executed.' This proposition is plain enough, but the application is difficult, for it requires a deep knowledge both of mechanical principles and of the means of carrying them out. Often the design of details of machinery is made with insufficient experience, sometimes far from the shops where they are to be constructed. Under these conditions it is unsafe to depend upon the most facile and economical manufacture. It is always easy to design complicated forms on paper, but it often makes useless work in the execution.

"Steinlen's merit is not limited to applying the doctrines mentioned. In regard to shop work he has always held the essential quality to be precision; that all the parts of a machine ought to be exactly constructed according to the indicated dimensions, so that they can be assembled without refitting or abnormal play; that the erector should be an erector, not an adjuster. Strength is another important factor in machine tools, so that they shall not be deformed by the weight of the parts or thrust of the cutting tools. These qualities ought to be lasting.

"In attaining an irreproachable construction there are commercial difficulties with which Steinlen had to contend. No matter how much pains has been taken to make their execution simple, the price of machine tools of irreproachable quality is always high, because of the use of choice material and of special operations needed, such as the rectification of hardened pieces by grinding. The buyer is often disposed to prefer a machine of almost as good appearance, although of lower quality and price. Steinlen would not concede to the preferences of these buyers. He held that the first thing is to establish a reputation, and the next thing to maintain it, and that users will not be blind to the economy of a good machine. The justice of this view is shown by the surviving reputation of decadent establishments.

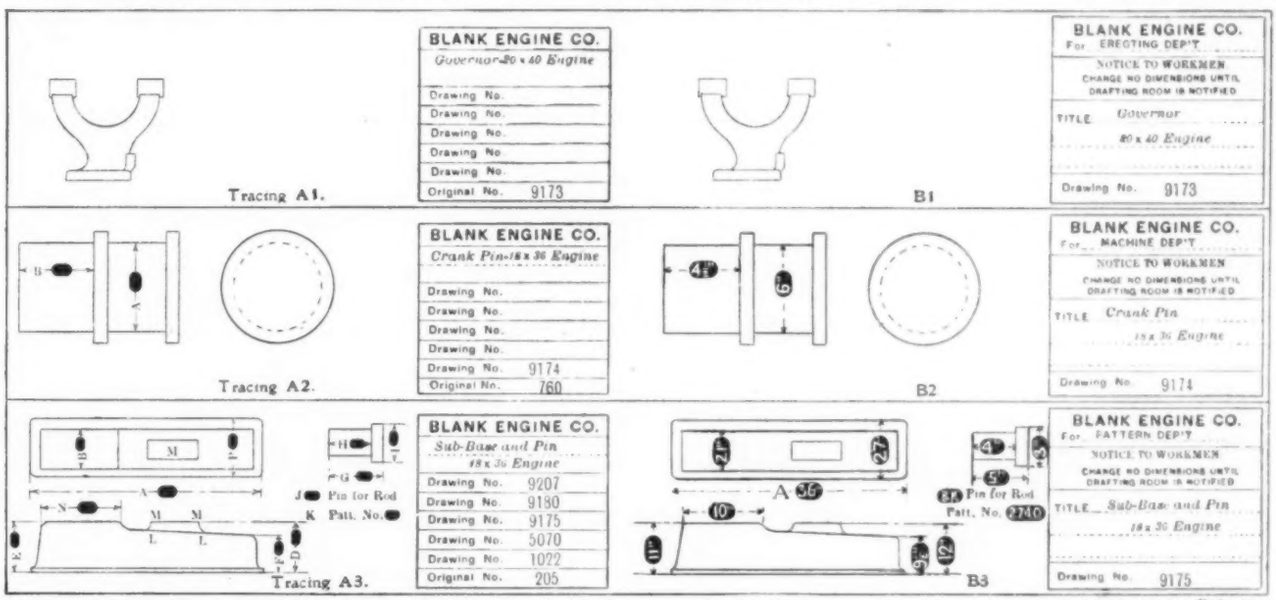
"The results of choosing this or that machine tool are not always easily appreciable by those who do not follow its work; wear and disablement, especially, being imperceptible until after a time. It would be well for the maker of a tool more frequently to state its capabilities explicitly and for the buyer to verify them on delivery. For instance, there might be stated the weight of chips removed per hour from a piece of mild steel, and, for finishing operations, the degree of precision attained. The diameter of a turned cylinder at various points might be given. This method would tend to eliminate poor and mediocre machines, help the sale of good ones and assist the control of those in current use.

" 'Those operations,' remarked Steinlen, 'which, it is alleged, require no precision—are they not justly among those which it is especially needful to be able to perform economically? Well, this can only be done by means of *powerful* instruments—which will be the more powerful if they are the more *precise*—attacking the piece of work as much as possible almost to the last. It should not be argued toward the end of a job that there is little more material to remove and that for this the tool does not need to be run as powerfully and accurately as during the roughing operation which preceded.'

"Steinlen is the type of the true engineer-constructor, at home both in the shop and the designing room, a master of all details. The harmonious simplicity of the forms of his machines shows him a true artist. His firm's exhibit at the Exposition of 1889 impressed exhibitors not only with the invididual beauty of the machines but with the unity of composition in the numerous series. Moreover, a salient feature of Steinlen's tools is their durability.

"M. Candelot, Colonel of Naval Artillery, long director of the naval foundries at Ruelle, has lately testified to the excellent results of numerous tools of Steinlen in service there. Among the types mentioned are precise milling machines and grinding machines of various sorts. Four lathes, used first at Nevers and later at Ruelle on heavy work, have, without repair, preserved their initial precision after some thirty years' service. A tool which has been used day and night since 1883 in boring 50-, 75- and 96-ton guns shows no sign of wear.

"It is to be admitted that Steinlen has done more or less imitation of American tools, but in so doing he has been accustomed to make improvements which gave them an original character. The first one he copied was a Brown & Sharpe turret



RECORD OF CHANGES IN DRAWINGS.

lathe purchased at the Paris Exposition of 1867. The copy (an avowed one) was shown at the Vienna Exposition of 1873, and Prof. R. H. Thurston, in a report, credited it with having reproduced not only the arrangement but the excellent construction of the original, and with being a machine of which the authors of the original might be proud.

"Among the tools built by Steinlen is a lathe for the French naval shops at Guérigny, with centers 1.7 meters high (11-foot swing according to American reckoning) and distance between centers 7 meters. It has two carriages with a special milling attachment to replace one of them. The lathe weighs, with accessories, 341 tons. Besides machine tools, he has built other machines, including printing presses, steam engines of the straight-line type and dynamos of the Gramme type.

"Steinlen is a Swiss, born in 1824, the son of a painter, from whom he has acquired artistic talent and taste in design. In 1841 he entered, as apprentice, a shop at Grafenstaden, near Strasbourg. In 1863 he entered, as engineer-in-chief, the Alsacian establishment then known as Ducommun & Cie., later being admitted to the firm, with which he remained till 1892.

"Steinlen was one of two delegates of the Société Industrielle de Mulhouse to the Philadelphia Centennial of 1876, and, in connection with a report on the same, gave an account of the characteristics of the personnel in American shops. Steinlen has always paid attention to the question of workmen and their training. He believes that machine tools ought not to be committed to unskilled hands.

"To conclude, Steinlen is an embodiment of the principle that true economy of manufacture exists in a good tool equipment, just as it exists in employing competent men. Is it not also economy to procure in good quality whatever one procures at all?"

Notes on Crane Design—Solenoids.

BY A. D. WILLIAMS.

Electricity and magnetism are mysterious to a great many, but their laws are well defined. The principal trouble in applying their equations is due largely to the unfamiliar units, metric and C. G. S. system, and, in addition, some Greek letters are used which have a very imposing appearance. A number of calculations have to be made, one of them a simple quadratic equation, and this is the highest branch of mathematics involved. All the required information can be found in Kent's Pocket-Book, but it is condensed to suit limited space. Thompson's "Dynamo Electric Machinery" covers the ground in very good shape, but contains a certain amount of calculus which cannot be avoided when this subject is thoroughly gone into. The general principles of solenoids are the same as those of field magnets. G. Kapp and Hopkinson can be consulted also.

Solenoids are extensively used in electric hoisting appliances, for releasing a brake, which is applied by a spring or the force of gravity. In either case the force to be overcome is a known one at the time the solenoid question arises. The solenoid must be powerful enough to do its work without failure. It is proposed to take this matter up in the way in which it comes up in practice, working out a solenoid to suit an assumed case, each step being explained, it is hoped, in a manner which will make it clear. A large portion of the calculations were made by means of a slide rule, and if worked out to the last figure some differences will be found.

Series Solenoid 25 H.P. motor 125 A. 220 v.
Weight to be lifted 45 # or 20 kg approx.
Normal lift 1" Max. lift 2" Air gap when up $\frac{1}{8}$"
Solenoid Core 2" dia - 20 cm² Area 11" or 28 cm long.
Spool 6" O.D. Winding Space 12" long x $1\frac{11}{16}$" deep.

Magnetic Circuit

Two Cores	20 cm² Area	11" or 28 cm long - Total length		56 cm.
Top Yoke	20 " "	11" " 28 " " "		28 "
Bottom Yoke	20 " "	8" " 20 " " "		20 "
		Total length in metal		104 "
Two Air gaps	20 cm² Area	2" or 5 cm long - Total length		10 cm

Saturation required

$$2\,\frac{20\,B^2}{25.12\times 981000} = 20 \qquad B^2 = \frac{25.12\times 981000\times 20}{2\times 20}$$

$$B = 3500$$

$$\Phi = sB = 3500\times 20 = 70000$$

for gap	A.T. = .8 x 3500 x 10	= 28000	
" metal	" = 1.4 x 104	= 146	
		28146 net A.T. reqd.	

Allowing for leakage A.T. = 28146 x 1.3 = 36600

Turns of wire $\frac{36600}{125} = 292$ or 146 per spool.

Conductor reqd. 125 x 667 = 83375 cir mills = { 1 - #1 A.W.G. / 2 - #4 "

Use #4 A.W.G. D.C.C. wire and connect spools in parallel
dia #4 wire bare .204" insul .014 dia over insul .218"

Spool will hold $\frac{12}{.218} = 55$ turns per layer $\frac{1.69}{.218} = 7$ layers

55 x 7 = 385 Turns
Allowing 10% for bedding 385 x 1.10 = 424 Turns per spool.

CALCULATION SHEET I.

In translating to the metric system a few liberties have been taken.

The accompanying calculation sheets give all the information, known and assumed, available. This matter is tabulated at the head of the first sheet. In work of this kind some sort of system should be followed and the calculation sheets should follow the same form and be filed so that past work can be found. Very often system in these matters is considered useless red tape, and time wasted, "but that is another story." The writer prefers to preserve all calculations on standard letter size sheets, each set being pinned together. These sheets are filed in ordinary letter files with a special index, home made, to suit his requirements.

The lifting power of a magnet can be calculated by the formula used for the attractive force between two opposite poles when their distance apart is small. In a solenoid both poles work together and the formula is:

$$2\,\frac{s\,B^2}{8\pi\times 981{,}000} = kg,$$

in which

s = area of pole piece in square centimeters,

B = number of lines of force per square centimeter,

kg = attractive force in kilograms,

$8\pi = 25.12$,

1 kg = 981,000 dynes.

Substituting the values of s, 8π and kg gives:

$$2\,\frac{20\,B^2}{25.12\times 981{,}000} = 20.$$

Transposing and performing the indicated operations:

$$B = 3{,}500.$$

The total number of lines of force

$$= sB = 70{,}000 = \Phi.$$

This formula is not strictly correct for the purpose, but practically it suits. The attraction between two unit poles varies

with the square of their distance, but in poles of appreciable area and close together, this law does not apply. In solenoids the pole is usually inside the coil and this affects the question also.

The lift or air gap is the most important element in determining the number of ampere turns requisite. The balance of the circuit can vary considerably with small effect on the general result, which permits the assumed circuit to be modified in case it is necessary. The number of joints in the circuit should be small, as each is equivalent to an addition to the air gap, though this is small and can usually be neglected. Each joint is equivalent to an air gap of .003 centimeters. The proposed circuit is tabulated on calculation sheet 1.

In regard to the material of which the magnetic circuit is composed, there is some diversity in practice. Norway or Swedish iron is sometimes used, but this is hardly necessary, as soft steel of good magnetic quality is readily obtained. Steel castings make good yokes, but gray iron and malleable iron are occasionally employed. The writer has assumed the use of soft steel for the magnetic circuit, and therefore a uniform sectional area. When different materials are used they must be proportioned inversely to their magnetic resistance.

The formula for the magnetic resistance or reluctance is as follows:

$$R = \frac{l}{\mu s}$$

in which

R = magnetic reluctance,
l = length in centimeters,
μ = permeability,
s = sectional area, square centimeters.

The equation for the number of ampere turns requisite is as follows:

$$\text{A. T.} = \frac{R\,\Phi}{1.257}$$

in which

A. T. = ampere turns,
Φ = the magnetic flux,
$1.257 = .4\pi$.

From these general equations the formula can be developed to suit any particular case. The magnetic circuit is usually composed of several elements which can be denoted by sub-numerals or letters. The equation for the case in hand, in which there are only two elements, the cores and yokes being taken together, is as follows:

$$\text{A. T.} = \frac{\Phi}{1.257}\left(\frac{l_1}{s_1\,\mu_1} + \frac{l_2}{s_2\,\mu_2}\right)$$

This equation cannot be used until the value of μ_2 is determined, and this depends upon the degree of saturation. For the gap $\mu = 1$. The best method is to calculate the number of ampere turns required for each part of the circuit separately. For air this can be done as follows:

$$\mu = 1 \quad \text{and} \quad \Phi = B\,s$$

$$\text{A. T.} = \frac{10}{4\pi} B\,l = .8\,B\,l.$$

#2
Series Solenoid 25 H.P. 125 R. 220 V.

$\frac{424 \times 12.76}{12}$ = 450 ft of wire per spool.

Weight = $\frac{450}{7.9}$ = 57# = 26000 grammes.

R @ 50° C = 450 × .0002771 = .125 Int. Ohms.

Watts lost per coil $62.5^2 \times .125 = 488$

Radiating Surface = $6^2 \times .7854 + 12 \times 6 \times 3.1416 = 254$ in²

$\frac{488}{254}$ = 1.93 watts lost per sq. in. of surface
.52 sq. in. per lost watt

Heat generated if current flows for Two minutes

H = 488 × 120 × .243 = 14200 gram calories

Rise in Temperature = $\frac{26000 \times .0952}{14200}$ = 1.74° C

CALCULATION SHEET 2.

For the case in hand this gives:

A. T. = .8 × 3,500 × 10 = 28,000.

For soft steel the values of μ are slightly greater than those given in Hopkinson's table (page 1065, Kent), varying so that no constant can express their relation, but it is safe to assume that the steel has 100 per cent. greater reluctance than iron as given in that table. This is only a rough approximation, but it is close enough for the purpose in this case. The values in this table for B are rather limited. The permeability of a substance is expressed by a coefficient μ, which denotes its relation to the permeability of air, which is taken as a unit. $\mu = B \div H$, in which H denotes the number of lines per square centimeter which will pass through an air space between the poles of a magnet, and B the number of lines which will pass through a certain piece of iron or steel in that space. Curves of B and H can be obtained from steel makers or plotted from this table. There are also tables giving the number of A. T. requisite per centimeter of length for varying values of B, based on Kapp's experiments. According to these, 1.4 A. T. are required per centimeter of length for cast steel if B = 4,000, and from this it would be found that μ = 2,270, which, according to Hopkinson's table, would be equivalent to a flux of 8,000 lines, over twice the flux for the case in hand. The total length of this part of the magnetic circuit is 104 centimeters, and

A. T. = 104 × 1.4 = 146,

or by means of the formula previously given,

$$R = \frac{104}{2{,}270 \times 20} = .00239$$

$$\text{A. T.} = \frac{.00239 \times 70{,}000}{1.257} = 128.$$

The total number of ampere turns is therefore 28,146.

The allowance for magnetic leakage varies from 12.5 to 50 per cent.; 25 per cent. is common, but the writer prefers to consider the loss as 30 per cent. on the net number of ampere turns, as found above. In this case

A. T. = 28,146 × 1.3 = 36,500.

The size of wire will be determined by the permissible rise in temperature, and whether the solenoid is to be connected in series or in shunt. The series solenoid must be able to carry the maximum current and to lift with the minimum current required by the motor. The shunt solenoid operates with a constant current and a constant voltage, and is wound to secure the proper resistance. This means a solenoid more closely adapted to its work, a finer sized and more expensive wire, and in some cases an external resistance will be necessary.

The current density permissible depends upon the proportion of the time the solenoid is in service and its radiating surface. The radiating area or exposed surface is the area of the top plus the area of the convex surface of the cylinder. For continuous service the current density is often taken at a figure that gives each square inch of radiating surface .4 of a watt to dispose, but in intermittent work higher figures can be used with safety. The depth of winding also should be considered. A shallow winding can carry more current than a deep one. For a crane solenoid 1,500 amperes per square inch of conductor is not excessive, and higher values have been used. 1 square inch = 1,000,000 circular mills. 1,500 amperes per square inch = 667 circular mills per ampere.

A 220-volt motor takes approximately 5 amperes per horse-power at its rated load. Series motors are usually employed, which can carry a considerable overload for a short time without trouble. Their speed increases as the load decreases, and the number of amperes consumed varies with the load. The size of wire for the

solenoid can be taken as a size smaller than that used in the motor field coils, but care must be used in this case to note how the field coils are connected and to have the solenoid coils connected in the same way.

The 25 horse-power street railway motor is frequently used on hoists, taking about 125 amperes at 220 volts, and solenoids to be used in series with this motor would require $\frac{36,600}{125} = 292$ turns, or 146 turns per spool. This is the minimum number of turns necessary, and would be sufficient if the motor always ran at full load, but this cannot be counted on, as a large portion of the time the load is comparatively light, and the solenoid must be able to lift at all times. Therefore a larger number of turns must be wound on the spools. In starting a motor there is always a sudden rush of current at first, as the resistance of the motor is very small, but this current drops very rapidly as the speed of the motor rises. The controller resistance in part acts to check this flush of current, but cannot completely overcome it. The number of amperes that flow at the start depend also upon the load the motor starts under, and it is not safe to depend upon this rush to operate the solenoid.

The size of wire to carry 125 amperes is equal to $125 \times 667 = 83,375$ circular mills, which is equivalent to one No. 1 or two No. 4 Brown & Sharpe gage wires. The smaller wire is much easier to wind. It can be put on in two ways. Both wires may be wound on each spool, the two spools being connected in series, or one wire can be put on each spool, which are then connected in parallel. Double cotton covered magnet wire should be used. The thickness of insulation on this kind of wire is given on page 1065, Kent's Pocket Book, and in lists obtainable from the makers of such wire. No. 4 (A. W. G.) is 204.3 mills in diameter and 218.3 mills over the insulation. The winding space on the spool is 12 inches long and 1 11-16 inches deep on each side, allowing for insulation around the tube and outside the coil.

$$\frac{12}{.218} = \text{turns per layer,}$$

$$\frac{1.69}{2.18} = 7 \text{ layers.}$$

$$55 \times 7 = 385 \text{ turns per spool.}$$

In winding, the wire flattens out a trifle and beds in the layer below, so that a spool holds from 10 to 20 per cent. more than the calculated number of turns. Allowing 10 per cent. to cover this, the spool will actually hold 424 turns of No. 4 wire. The minimum winding required is 146 turns of No. 1 wire, carrying 125 amperes on each spool. No. 4 wire can only carry 62.5 amperes, therefore 292 turns will be necessary. The spool holds 424 turns, or about 1.4 times the number arrived at by calculating on the normal current for the motor. In practice the motor is very rarely overloaded or even fully loaded, and the solenoid must be able to lift when the motor is started without a load. The normal lift is 1 inch, and the solenoid should act with about 20 amperes.

The length of wire per spool is equal to the number of turns multiplied by the average circumference. In this case

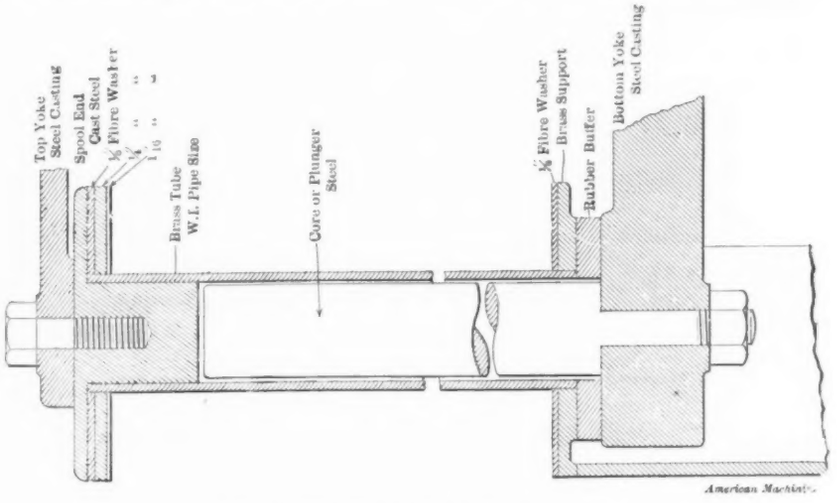
$$\frac{424 \times 12.76}{12} = 450 \text{ feet per spool.}$$

The resistance of No. 4 (A. W. G.) copper wire at 50 degrees Cent. = .0002771 international ohms per foot.

$R = 450 \times .0002771 = .125$ ohms per coil.

The lost watts and heating effect are the same if each coil is wound with a single wire, the spools being connected in parallel, or if each spool is wound with two wires in parallel and the coils connected in series. The lost watts per coil $I^2R = W$. This is calculated for the normal full load current.

$62.5^2 \times .125 = 488$ watts lost per coil.



THE CONSTRUCTION OF SOLENOID SPOOLS.

The radiating surface is 254 square inches; hence $\frac{488}{254} = 1.93$ watts lost per square inch of surface, or .52 square inch per lost watt.

This would imply a rather heavy rise in temperature, if the current was on for any length of time, but in this service there are a great many rests. A run of two minutes is more than the ordinary hight of hoist will permit. The heat generating power of such a run will be:

$H = 488 \times 120 \times .243 = 14,200$ gram calories = 56 British thermal units.

H = heat generated in two minutes, gram calories.

There are 450 feet of wire per spool, or about 57 pounds of copper. The specific heat of copper is .0952.

$$57 \text{ pounds} = 26,000 \text{ grams.}$$

$$T = \frac{26,000 \times .0952}{14,200} = 1.74° \text{ C.}$$

T = rise in temperature in two minutes, degrees Cent.

That is, in a run of two minutes the temperature of the coil will be raised 1.74 degrees Cent., less the heat radiated in that length of time. If no heat was lost by radiation, and the temperature of the coil was 20 degrees Cent. at starting, it would take 45 minutes to raise its temperature to 60 degrees Cent., or 140 degrees Fahr. To do this the full load would have to be raised at full speed for this length of time. Actually, the heating effect is not as great as calculated, as the resistance of the wire is less when cold, and it would take a greater length of time than figured to produce the effect stated. The efficiency of the radiating surface increases as the difference in temperature between the coil and the surrounding air increases. The pauses, when current is not flowing, are frequent, and the current is slightly less in lowering, so there is ample opportunity for the coil to cool a little. It is quite possible, however, to burn out the solenoid, but this will not disable the crane completely, as by cutting it out and rearranging the connections the machine can be operated without the magnetic brake, which in this case is blocked so it will not act.

Shunt solenoids are sometimes employed. The method of proportioning their winding is similar to that for series solenoids, except that the current to be used is fixed, and the resistance of the coils alone is made sufficient to permit this amperage. In some cases it may be found desirable to have a higher resistance than can be conveniently obtained in the spool itself and an external series resistance is used in this case.

The shunt solenoid, however, is not affected by variations in the current used by the motor, and thus can be better proportioned to its work.

A shunt solenoid used, under the stated conditions, on a 220-volt circuit and taking 4 amperes, would require about 10,500 turns of wire, or 5,250 turns per spool. The resistance would be 55 ohms, or 27.5

ohms per spool. This might not fit a commercial size of wire, and would be modified in practice with this end in view. For a shunt solenoid the allowance for magnetic leakage should be 50 per cent.; the above figures are on this basis.

The accompanying illustration shows a method of constructing solenoid spools. The spool shank consists of a piece of heavy brass tubing. One end of this tube is screwed or expanded into a brass support, suitably arranged to bolt on to the frame of the machine. The upper head consists of a steel or cast-iron plate, with a boss in the center which is forced into the brass tube. This tube is insulated by a layer of micanite or vulcanized fiber, over which the wire is wound. The ends of the coil are insulated by fiber washers, three at the upper and one at the lower end. The middle washer at the top is slotted to lead the wire in to the center of the coil. When the winding is put on, each layer should be shellacked, and it is a good plan to put on a layer of micanite when half the wire is on and complete the winding over this. When wound, a layer of press board is put on and the outside served with cord and given a coat of black shellac.

Rubber buffer washers should be placed around the magnet cores to reduce the shock when lifting, or the constant hammering will break things. The cores may hang a bit at the start, but when they get started the rise is very sudden. The bottom yoke is suitably arranged to connect with the brake lever by means of links and pins. The yokes should have all corners well rounded to avoid magnetic leakage. The steel used should be as soft as possible.

Graphic Integration for Volumes.

BY EDGAR H. BEKRY.

At page 1456 "Anonymous" requests a formula for the volume *a b c*, Fig. 1, formed by the intersection of a cylinder and a sphere. In lieu of a formula I offer the graphic solution outlined below:

In general any volume is equal to $\int z\,dx$, where z = the area of that cross-section of the volume which lies at a distance x from the origin.

Also any area is equal to $\int y\,dx$, where y = the width of the area at a distance x from the origin.

If we now determine the values of z corresponding to various values of x, and draw a plane curve whose ordinates y are numerically equal to z, the area $\int y\,dx$ will be numerically equal to the volume $\int z\,dx$. Thus the required volume may be obtained indirectly by measuring the area $\int y\,dx$.

Draw a side and end view of the cylinder and sphere as shown in Fig. 2; then $F_1 A_5 A_7 C_7$ is the required volume. It will be most convenient to determine the volume $F_1 C_7 F_7$ and subtract this from the volume of the cylinder $F_1 A_5 A_7 F_7$.

In the side view draw the ordinates $A\,B\,C$, etc., at convenient distances apart. With radius $B\,B_1$ draw the circle $B_2 B_3 B_4$, with radius $C\,C_1$ draw the circle $C_2 C_3 C_4$, etc., all of these circles having the common center O, coinciding with the center of the sphere.

The area of a cross-section through the required volume at B is evidently equal to the area of the cross-section of the cylinder, diminished by the portion cut away by the sphere. This latter portion is represented by $B_2 B_3 B_4$. Similarly at C the cross-section of the cylinder must be diminished by the area $C_2 C_3 C_4$, at D it must be diminished by the area $J D_2 D_3 D_4$, etc. The areas to be subtracted are reproduced for greater clearness in Fig. 3.

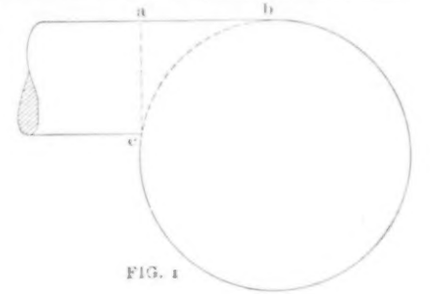


FIG. 1

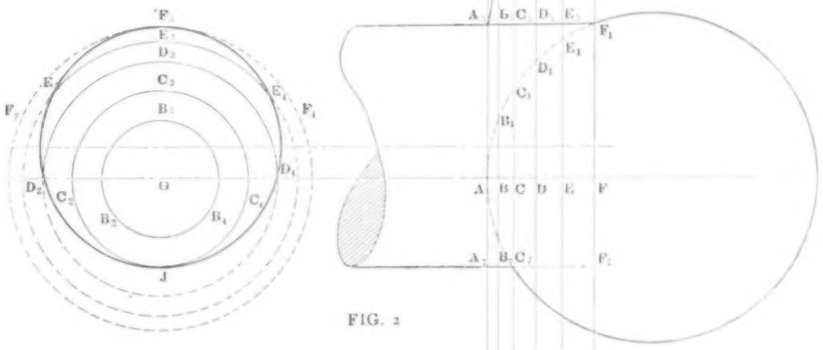
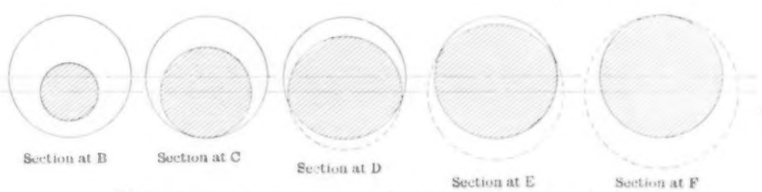


FIG. 2



Shaded areas represent portions cut away by sphere.

FIG. 3. GRAPHIC INTEGRATION OF VOLUMES.

Determine these several areas, preferably by means of a planimeter, and on each of the ordinates B, C, etc., Fig. 2, lay off above the top of the cylinder a hight representing the corresponding area. Thus $B_5 B_6$ corresponds to area $B_2 B_3 B_4$, $C_5 C_6$ corresponds to area $C_2 C_3 C_4$, etc. The last ordinate $F_1 F_6$ corresponds, of course, to the area of the entire cylinder, as at this point the cross-section of the required volume is reduced to zero.

Through the points $B_6 C_6$, etc., draw a smooth curve and measure the area $A_5 F_6 F_1$ with a planimeter. This area is numerically equal to the volume cut away by the sphere from a cylinder of diameter $A_5 A_7$ and length $A_5 F_1$.

In graphic processes the principle remains the same regardless of the scale employed, but in actual practice an unsuitable scale may make the diagram too large or too small for conveinent use, or it may so distort the curves that a trifling error in a reading may be greatly magnified in the final result. It is not necessary that the same scale be employed for all the operations, provided that a suitable correction is made in the answer, and it may often be very advantageous to draw different parts of the diagram to different scales.

In the case under consideration, assume the planimeter to be set to read areas in square inches. Then, if the side and end views are drawn to a scale of $\frac{1}{s}$, the true area of each cross-section would be obtained by multiplying the planimeter reading by s^2. If the ordinates representing these areas are now laid off to such a scale that a hight of $\frac{1}{t}$ inches is laid off for every square inch of the planimeter reading, each inch of length represents $s^2 t$ square inches of cross-section. As the abscissæ of the final curve are laid off on the side view which is drawn to a scale of $\frac{1}{s}$, each square inch of area underneath

this curve represents $s^3 t$ cubic inches of volume.

Hence if v = final planimeter reading,

$\frac{1}{s}$ = original scale of diagram,

$\frac{1}{l}$ = scale used in plotting preliminary planimeter readings,

volume $F_1 A_5 A_7 C_7$ = volume $F_1 A_5 A_7 F_7 - s^3 t v$.

Diagrams for Semi-Elliptic Plate Springs.

BY LAWFORD H. FRY.

It may be safely assumed that anyone habitually engaged in the application of engineering principles to particular cases—that is, in the use of engineering formulas—is a confirmed user of a slide rule or a chart of some kind to reduce to a minimum the labor of the calculations. For formulas infrequently used a slide rule will probably be most satisfactory, but when the same formula is used constantly a chart can generally be constructed to give results more rapidly and more readily than the rule. The accompanying charts

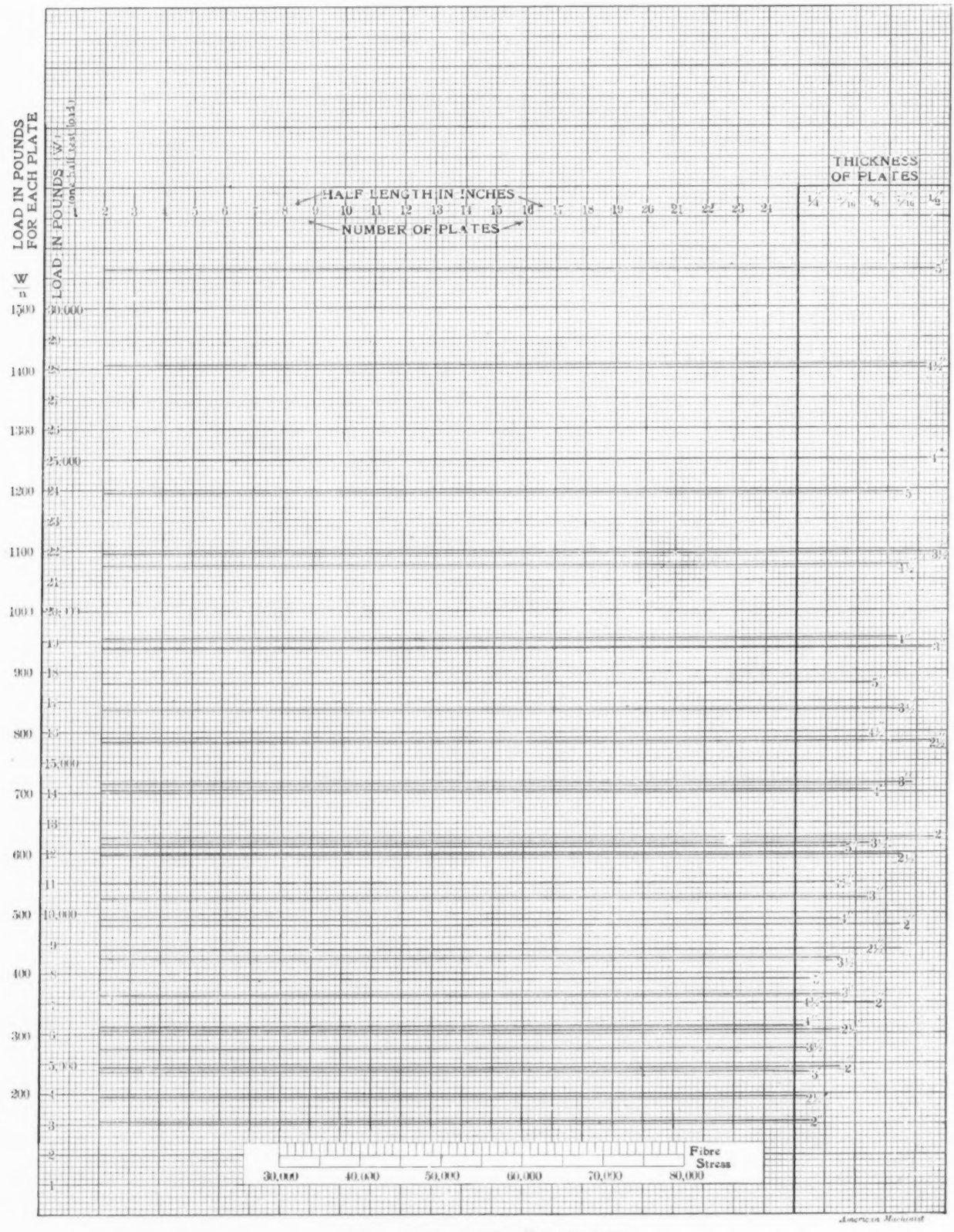


FIG. I. SPRING DIMENSIONS AND LOAD.

embody the formulas used in the design of semi-elliptic plate springs such as are used on railroad rolling stock.

Fig. 1 is a combination of two charts, the two scales down the left-hand edge serving separate purposes. The inner scale gives the relation between spring dimensions and load for a working fiber stress of 75,000 pounds per square inch, while the outer scale gives the more general relation between spring dimensions and load for any fiber stress between 30,000 and 80,000 pounds per square inch. The chart in Fig. 2 gives the relation between spring dimensions, fiber stress and deflection.

Method of Operation.—Having given the length of the spring, the width and thickness of the plates, to find the number of plates required to carry a given load. For example, the spring is to be 32 inches long between centers, built of plates 3½ inches wide by 7-16 inch thick. Required the number of plates to carry 18,000 pounds. From the columns at the right is found the horizontal line corresponding to plates 3½x7-16 inches, and the intersection of this line with the vertical line corresponding to the half length, 16 inches. Through this intersection and the origin at the lower left-hand corner is drawn a diagonal line. The intersection of this with the horizontal load line is found to lie between the verticals for 17 and 18 plates. The spring should be built with 18 plates. With this number of plates the actual working fiber stress is found from the outer left-hand scale and the scale at the bottom of the chart. Dividing the load by the number of plates the load per plate is found to be 1,000 pounds. This figure being taken on the outer left-hand

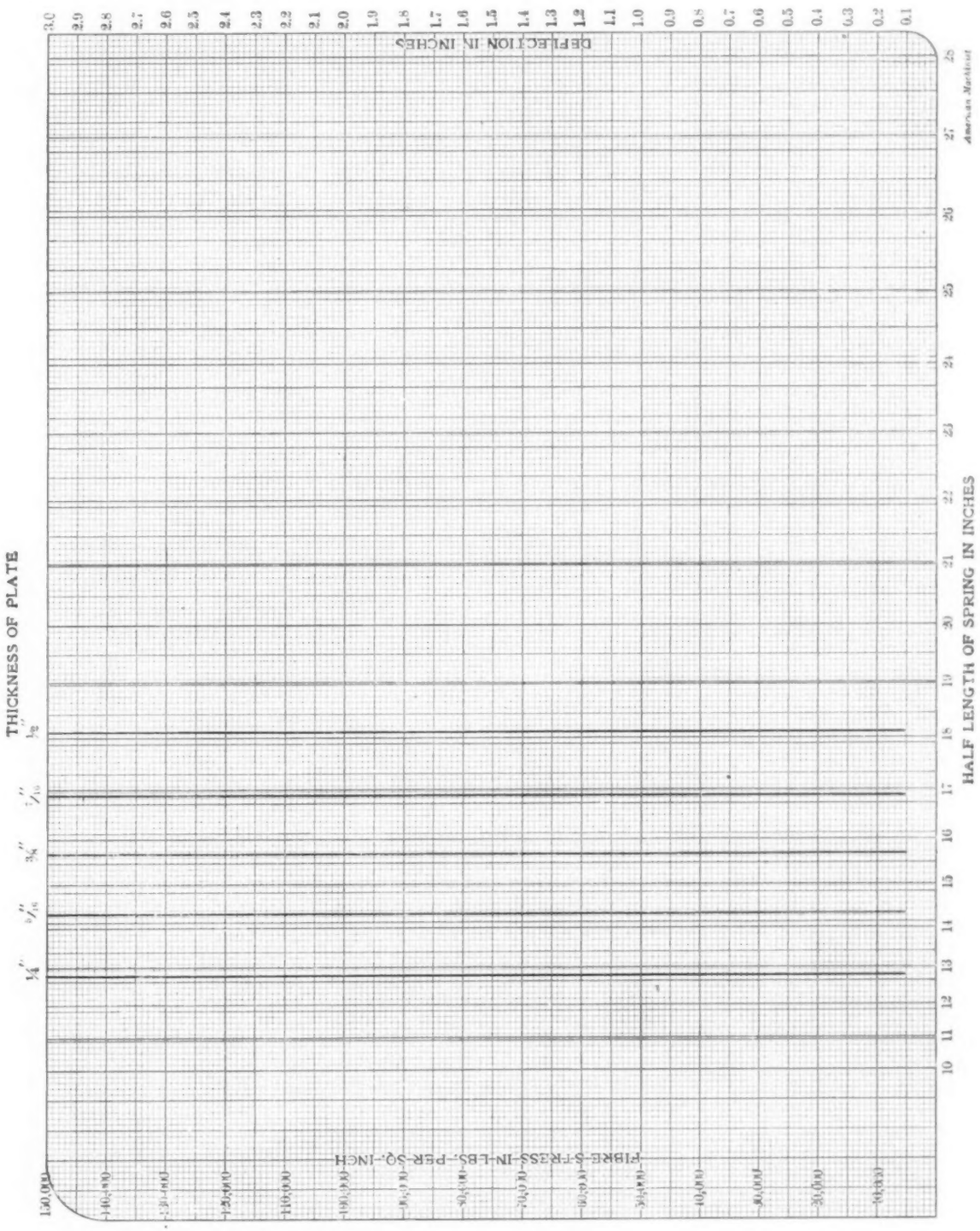


FIG. 2. DIAGRAM FOR DIMENSIONS OF SPRING, FIBER STRESS AND DEFLECTION.

scale, the horizontal is followed to its intersection with the diagonal determined by the spring dimensions, and the vertical through this intersection is followed down to the lower scale on which the fiber stress is read as 72,000 pounds per square inch. With this information the deflection is found from Fig. 2. A diagonal is drawn from the origin to pass through the intersection of the vertical line for the plate thickness, 7-16 inch, and the horizontal fiber stress line 72,000 pounds per square inch. The vertical half-length line, 16 inches is followed to its intersection with the diagonal and from this intersection a horizontal line is followed to the right-hand scale, where the deflection is read as 1.29 inches.

Of course the problem may be varied and one of the other quantities may be that which it is required to determine. For example, with a given deflection, by reversing the operations described above the corresponding fiber stress can be found from Fig. 2, and then from Fig. 1 the load corresponding to this fiber stress can be found. As previously stated, the inner scale at the left of Fig. 1 corresponds to a maximum fiber stress of 75,000 pounds per square inch, this being taken as representing ordinary good practice. If, however, it is desired to work with another fiber stress the outer scale will enable the chart to be used. For example, the spring calculated above, 32 inches long with plates 3½x7-16 inch, is to work with a fiber stress of 60,000 pounds per square inch, and the requisite number of plates is to be found, the total load being 20,000 pounds. The diagonal from the origin is drawn as before, through the intersection of the length line and the plate section line, and the vertical from 60,000 on the fiber stress scale is followed to meet the diagonal. The reading on the outer left-hand scale for this intersection gives a load of practically 840 pounds per plate, so that the number of plates required is

$$\frac{20{,}000}{840} = 23.8\text{—say, } 24 \text{ plates.}$$

In using the charts it will be seen that care must be taken to use the proper intersection points. In Fig. 2 the diagonal from the origin must go through the intersection of length and deflection, lower and right-hand scales, and the intersection of thickness and fiber stress, upper and left-hand scales. To indicate this the lower right-hand and upper left-hand corners are drawn rounded, indicating that the scales joined by the curved lines are those which must intersect. In Fig. 1 in both charts the intersection of the length and the section lines are taken—that is, the two scales relating to the size of the plate—and by bearing this in mind the proper intersection should be easily found. The reasons for this choice of intersections will be obvious from an examination of the principles governing the construction of the charts.

Construction of the Charts.—The charts in Fig. 1 are based on the formula:

$$W = \frac{n f b h^2}{6 l} \qquad (1)$$

where

W = total load carried by the spring in pounds,
n = number of plates,
b = breadth of each plate in inches,
h = thickness of each plate in inches,
l = half the length of the spring in inches,
f = maximum fiber stress in pounds per square inch.

The chart for determining the number of plates is based on a maximum fiber stress of 75,000 pounds per square inch, so that the formula is reduced to the form:

$$W = 12{,}500 \frac{n\ b h^2}{l} \qquad (2)$$

or by transposition

$$\frac{W}{n} = 12{,}500 \frac{b h^2}{l}$$

This equation is naturally divisible into

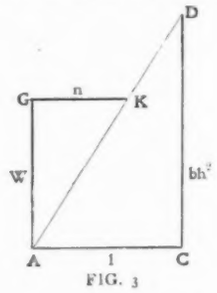


FIG. 3

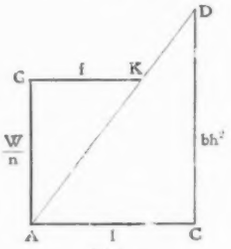


FIG. 4
American Machinist

RELATIONS OF THE QUANTITIES.

four terms: W, the weight, n, the number of plates; b, the length of the spring, and $b h^2$, a quantity determined by the section of the plates. These four terms are connected by a simple law of proportion, which is very readily expressed in geometrical form.

For if $A C$, Fig. 3, be laid off proportional to l, $C D$ proportional to the product $b h^2$ and $A G$ proportional to W, it is obvious that $G K$ will be proportional to n.

In constructing the original chart, Sibley College squared paper was used. The vertical scale for W was drawn with 4,000 pounds to the inch, the horizontal scale for l being drawn with 1 inch representing 4 inches of half-length of spring, and the vertical scale for $b h^2$ drawn so that the unit value of the product, $b h^2$, is represented by 6¼ inches.

The scale for n is determined by the choice of the other three scales, and for the above case is easily found as follows: By transposing equation (2)

$$n = \frac{W l}{12{,}500\ b h^2} \qquad (3)$$

and taking the values:

W = 12,500 pounds,
l = 15 inches,
b = 4 inches,
h = ½ inch,

$$n = \frac{12{,}500 \times 15}{12{,}500 \times 4 \times \frac{1}{4}} = 15 \text{ plates.}$$

The length $G K$, Fig. 3, representing n can be found by calculation or by drawing a diagonal through the origin to the intersection of the length and $b h^2$ lines, and noting the intersection of the load line with this diagonal. The length $G K$ corresponding to 15 plates is found to be 3¾ inches, or ¼ inch per plate, so that the scales for the length and the number of plates are found to coincide, as shown.

To determine the fiber stress for a given load the same basic formula (1) is used, but the number of plates is eliminated, the load per plate being taken instead of the total load. As the chart is chiefly used for determining the fiber stress in a given spring under a given load this works satisfactorily.

By transposing formula (1)

$$\frac{W}{n} \cdot \frac{1}{f} = \frac{b h^2}{l} \qquad (4)$$

In this the four terms are:

$\frac{W}{n}$ = the load per plate,
f = the fiber-stress,
$b h^2$ = the section factor,
l = the length of spring.

The same geometrical relation holds as before, the terms being represented as shown by Fig. 4.

In constructing the chart, the scales for $b h^2$ and l remain the same as for the previous chart, and therefore the two charts may be advantageously combined, as in Fig. 1. The scale for $\frac{W}{n}$ is laid off vertically, and is the outer scale on the left-hand margin in Fig. 1. In the original the most convenient scale was found to be 200 pounds to the inch. The proper scale for the fiber stress is then determined by the same method as was used above for the scale for the number of plates. With the scales chosen the fiber stress scale works out to one inch representing 15,000 pounds per square inch. This scale is laid off at the bottom of the chart in Fig. 1.

From the foregoing the interpolation for any plate of dimensions not covered by the chart will be seen to be very simple. The value of $b h^2$ being calculated, this is laid off vertically to the proper scale and a horizontal line is drawn.

The chart in Fig. 2 is based on the formula for the deflection of springs given in Mr. G. R. Henderson's paper, Trans. A. S. M. E., Vol. XVI, page 92.

$$d = \frac{5.5\ W l^3}{E n b h^3} \qquad (5)$$

where d = deflection in inches,
E = modulus of elasticity.

Now, combining this with formula (1) by inserting in (5) the value of W given by (1), we obtain, after cancellation, the equation:

$$d = \frac{5.5\, f\, l^2}{6\, E\, h} \qquad (6)$$

or giving E the value 30,000,000:

$$d = \frac{5.5}{180{,}000{,}000}\,\frac{f\, l^2}{h} \qquad (7)$$

Here, as for the former charts, an equation is obtained containing four terms which can be geometrically represented by the sides of two similar triangles. In constructing the chart convenient scales are chosen for the deflections, the fiber stresses and the half lengths, and in laying out the latter it must be noted that the distance of the line representing the half length from the origin must be proportioned to the *square* of the half length. The lines representing the plate thicknesses are found by calculating for each thickness the deflection for a given fiber stress and length, and then drawing a diagonal from the origin through the intersection of the deflection and length lines. Through the intersection of this diagonal with the fiber stress line is drawn a vertical representing the corresponding thickness. In formula (5) the constant 5.5 is arbitrarily chosen and depends largely on the design of the spring; the chart in Fig. 2 is therefore not applicable to all springs, but it is very readily adjusted to any other formula for deflection, as the form will be the same. It will be only necessary to relocate the thickness lines as described above, calculating the deflection from the new formula.

A Variable Speed Friction Clutch.

The accompanying cuts show an interesting friction clutch device recently patented, by means of which several different rotative speeds may be applied or released by the movement of a single sliding sleeve. Fig. 1 shows a form of the device in elevation and Fig. 2 the same in section. The lower shaft is in this case assumed to be the driver and the upper shaft is driven. The shafts are connected by three pairs of spur gears, or gears and pinions, of different ratios, which will give three different speeds as each becomes the operative transmitter. All three of the pinions are keyed fast upon the driving shaft and are constantly in mesh with their respective gears. These gears run on loose sleeves on the driven shaft, the other ends of the sleeves having friction wheels which are successively clutched and made to drive the shaft by this device. The sliding sleeve has three pairs of lugs to which are attached three pairs of connections operating upon three pairs of levers which move the friction shoes in or out. When the sleeve is slid along the shaft, so that either pair of connections come to a position at right angles to the axis of the shaft, then the friction shoes operated by those connections and their levers become the drivers, while all the other friction shoes are held away from driving contact. In Fig. 2 the lower side of the shaft shows the friction engaged in driving position, while on the upper side of the shaft the friction shoe is out of engagement. These would usually not come upon opposite sides of the shaft, but are shown in this way for convenience. In Fig. 1 the sleeve is shown drawn so far to the right that neither of the frictions is engaged. As the sleeve was moved to the left, the upper and lower opposite levers would come to the driving position. A further movement to the left would release this drive and bring the next one into operation, and so on. It will be noticed that from the release position the first movement of the sleeve brings the slowest movement into operation and the larger speeds in succession, the last being the fastest, which makes the start as easy as possible, and in connection with the friction the shock of starting should be reduced to a minimum. The patentee of this device is William A. Wood, Ansonia, Conn.

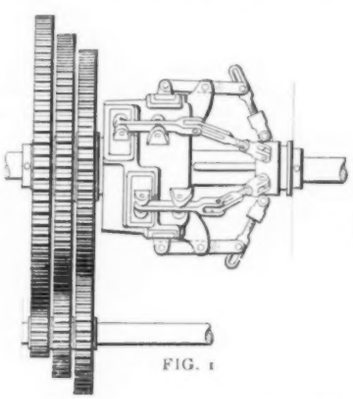


FIG. 1

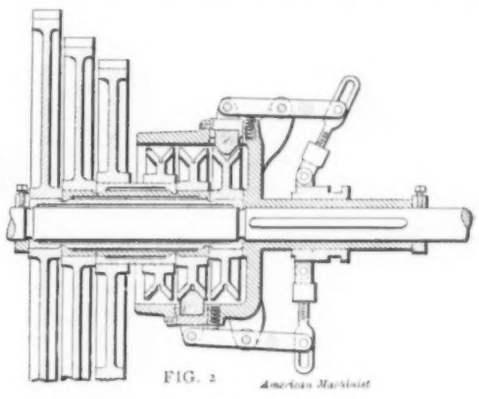


FIG. 2

A VARIABLE SPEED FRICTION CLUTCH.

Saving in One Department and Losing in Another.

BY G. E. FLANAGAN.

The following instance is one of the most annoying out of a great many in which an ill-considered effort was made to build machinery without providing suitable drawings. A machine was required that was in many respects a duplicate of some which had been previously furnished, but differing therefrom in several important particulars. A general drawing of the machine was made, with a bill of material upon it calling for details as shown on a number of existing drawings. These details were known by a letter combined with the number of the drawing upon which they appeared, and they were so designated in this bill of material, but many of them were followed by the remark, "To be modified as shown on sheet 3327," this being the number of the drawing itself upon which the reference occurred, a fact which uniformly failed of recognition until the parties interested had spent some time in looking for it, very often carrying the drawing around in their hands while asking others if they had seen it. Had the expression "As shown on this sheet" been used in place of giving the number, this trouble would not have occurred; but as it was, many a dollar's worth of time was spent by patternmakers and machinists in searching for that which was not lost.

The desire to save expenses by using old drawings for new work is one that is yielded to very freely by those who have charge of such matters, but it should be done with rare good judgment in order that it may not cost more than it saves. It does not take many hours' time of a high-priced machinist operating an important shop tool to equal the cost of a new tracing made by a youngster in the drawing room, on 15 cents' worth of tracing cloth, with tools of merely nominal value, and which are usually his own, anyway. The time lost in the machine shop on account of incomplete drawings does not appear upon the cost sheets as being due to this cause, and the powers that be seldom realize the extent of the leakage from this well-meant effort to save. Again, if several sets of blueprints are required to see the work through the shop, the mere cost of printing many copies of a large sheet from which only one or two details are used may of itself more than offset the cost of collecting these details together upon a single new tracing. Of course, if the tracing is made by a boy, it must be checked by some more responsible person to avoid the chance of errors; but when this only means comparing it with the original, it amounts to but little. In a shop doing a great variety of work, the foreman's duties are sufficiently burdensome without calling upon him to deal with drawings that are in any way uncertain or obscure.

Cost reduction is to be commended when it can be attained fairly, but one department should not be permitted to make a showing in this respect if it is only done at the expense of a still greater loss in another. The wise manageme..t will see to it that each division of the plant shoulders its own proper burdens

and does not attempt to shift them on to others, or, at any rate, will not permit the attempt to succeed. This implies that the general manager should have a knowledge of the workings of all the departments under him, and certainly this is essential to the attainment of the best results. A one-sided man is very apt to attain results closely corresponding with his own characteristics. If he is a machinist, and only a machinist, he will fail to properly appreciate the interests of either the foundry or the pattern shop; if he is a draftsman merely, he will see everything through draftsman's glasses, and other departments will have problems to solve and difficulties to overcome which should never have reached them. The patternmaker will be expected to work with second-grade lumber and inferior tools, the need of having stock on hand and having it well seasoned will not be felt except by those who have the working of it. Wooden fillets will be made by hand when it would be much cheaper to buy them, or perhaps to use leather or lead ones. The pattern shop will be kept short of help, and as a consequence the foundry will be supplied with worn-out, patched and inferior patterns, causing a very serious increase in the cost of molding. A man of this type is also very likely to insist that all bolt holes must be made with cores; or, worse still, that the pattern must be made to leave its own cores, no matter what the inconvenience of molding, thus adding to foundry costs under the impression that he is saving in the machine shop, and it is often the case that these holes require to be chipped to such an extent when the parts are assembled that it would have been much cheaper, all things considered, to have drilled them out of the solid. In these days of rapid drilling in cast iron, it seldom pays to core small holes in castings unless the foundry can be depended upon to get them just right. It consumes more time and is harder on a drill to enlarge a single hole that has been cored too small than to drill a number in clean solid iron. Very heavy castings in which small holes are cored almost invariably give trouble; the cores do not stand the intense heat and the holes are found to be small and crooked. In steel castings, the case becomes much more aggravated and much coring is done that might be drilled at a less cost, to say nothing of the difference in the work when done.

When a saving in one department involves an increased expenditure in another, the person upon whom the decision rests must be able to balance the one against the other, and not be led away by the mere impulse to save, for saving at the wrong time and place is often a very costly proceeding. Sometimes the actual cost in dollars is not the only consideration, nor even the principal one. The foundry must be kept supplied with patterns, and if we cannot get perfect ones as rapidly as required we must admit a few for the time being that are perhaps not all that they should be, and even though the resulting castings cost slightly more to machine; but this is a condition which need not exist very frequently in a well-regulated establishment. In the machinery manufacturing business, the machine shop is usually the most expensive part of the plant both to install and to maintain; it is the objective point at which the work of all the other departments is aimed, and, generally speaking, anything which is allowed to impair the productiveness of the shop will result in a loss of profit. If the foundry is too small to keep the shop working up to its maximum degree of effectiveness, it should be enlarged, and this is also true of the pattern shop in relation to the foundry, and most emphatically true of the drawing office in its relation to the entire plant. It does not pay to lose time anywhere about the plant for the sake of saving the price of an extra draftsman. Some small shops dispense with draftsmen altogether, but they remain small shops.

That it is difficult for a man who has not had some all around experience to appreciate the conditions of work in other lines than his own is shown by the following incident: Complete drawings had been made for a full set of valves comprising many different sizes and several types of each size. The patternmaker made an error in one of these and wished to let it stand and have the drawing changed to suit the pattern, and I had to go to some pains to convince him that my refusal to do so was not a mere arbitrary decision to stick to the drawing. To him, it meant only changing a few figures upon one drawing, but actually it involved a great deal more than that. It would have been absolutely necessary to change the drawings of all the different types of valves of that particularly size, and to be consistent all the others would have had to be modified to preserve the unity of design throughout the set, since the error made the valve larger in some of its dimensions than the size next above it.

Alcohol Motors in Germany.

United States Consul Hughes writes from Coburg of the wonderful strides that Germany has been making within the last year and a half in the development and use of alcohol motors, due largely to the personal interest of the Emperor and the low price of alcohol, spirit containing 90 per cent. of pure alcohol being sold for 5 cents a quart. He says:

"The great advantages of a spirit motor over the ordinary steam engine are that it is always ready for use, without preliminary warming up; it can be filled, oiled and started in from two to three minutes; there is no constant supplying of coal and water, and no danger of fire or explosion; no permits are required from Government authorities, and there is no compulsory inspection; the spirit is easily obtainable in all districts; there is no smoke or smell, and the weight of a portable spirit motor is about one-half that of a portable steam engine of equal power.

"With regard to cost, a large German firm that exhibited at Halle showed 6 to 8 horse-power portable alcohol motors for $973.30; 10 to 12 horse-power motors for $1,265.29, and 16 to 20 horse-power motors for $1,581.61. In the tests made, one trial showed a consumption of 0.42 kilogram (0.92 pound) of 86-per-cent. spirit and 0.37 kilogram (0.81 pound) of a mixture of one-fifth benzol and four-fifths 86-per-cent. spirit, in both cases per brake horse-power per hour. If our American automobile manufacturers wish to capture the German market with their lighter, better and more stylish runabouts and pleasure wagons, I think they would do well to adopt alcohol as a fuel."

For Cleaning and Soldering Metals.

Jesse H. Young, of Fort Wayne, Ind., has recently obtained a United States patent for a composition of matter to be used for cleaning and soldering metals. The ingredients are: Distilled water, 8 ounces; ammonia, ½ ounce; sal-ammoniac, 10 grains; potassium cyanid, 3 ounces. The specification says:

"The above-named composition is intended for use as an anti-oxidizer and in making hard-solder joints. It also serves as a pickle for cleaning metal. In using my composition for soldering the parts to be joined, together with a piece of suitable solder, are dipped into the fluid or the fluid may be applied, as with a brush. The metal, with the solder in place, is heated gradually until the solder is about to flow, when additional fluid is applied, as with a brush. Heat is then applied until the solder flows and completes the joint. Before the metal has cooled considerably it may be immersed in the fluid, in which event the metal will become cleansed from the usual tarnish and adhering foreign substances due to the soldering process.

"In cleaning articles of jewelry the article is immersed in the fluid momentarily and then washed in water. In removing tarnish from such articles as engraved band and chased rings the article may be heated slightly and then immersed in the fluid."

Barth's Lathe Speed Slide Rules.

At page 1075 we illustrated and described a circular slide rule, designed by Mr. Carl G. Barth, of Swarthmore, Pa., for finding the working strength of gears, and we show herewith another instrument of the same class for determining the number of revolutions which a lathe should make in order that the surface speed of the work may be correct.

Mr. Barth, we may add, was associated with Mr. Taylor at Bethlehem, Pa., in the

development of the Taylor-White high-speed tool steel and the need of such an instrument for determining the speed of the work quickly, in order that full advantage may be taken of the capacity of the tool steel for high speed, was there forced upon his attention. The present instrument is the most "shoppy" of any special slide rule that we have seen, and is the final result of a large amount of effort to develop an instrument for this purpose.

BARTH'S SPEED SLIDE RULE.
COPYRIGHT 1902, BY CARL G. BARTH
FOR LATHES, BORING MILLS, DRILL PRESSES, ETC.
300 DIAMETER OF WORK.
CUTTING SPEED IN FEET PER MINUTE.
FOR TIME IN MINUTES FOR 10 REVOLUTIONS.
American Machinist

FIG. 1. BARTH'S GENERAL SPEED SLIDE RULE.

Fig. 1 shows the instrument in its general form. Like the gear slide rule, it consists of two superimposed disks, of which the upper and smaller turns about a stud located at the center of the larger. Supposing that it is desired that a 9-inch shaft, for example, should run at a surface speed of 40 feet per minute, it is only necessary to set 9 of the scale on the smaller disk against 40 of the adjacent scale on the larger disk, when, against the inner arrow head, we read 17, which is the number of turns which the shaft should make per minute, and, against the outer arrow head, we read .6 (nearly), which is the fraction of a minute in which the shaft should make ten turns—either of these determinations being used according to convenience or preference.

Fig. 2 shows the same instrument as arranged for one particular lathe or boring mill. In this instrument the lines on the outer circle of divisions represent the various speeds which the cone pulleys and back gears of the machine will give. The instrument is shown set for a 9-inch shaft at 40 feet, as before, and the inner arrow head again shows 17 revolutions per minute as the proper speed. The outer arrow head, however, now shows the arrangement of belt and back gears which comes nearest to giving this speed. The symbols *2-B-S* at the line nearest the arrow head show that the belt should be on the second step of the cone pulley; that the back gears should be in, and that the countershaft should be driven at its slow speed—the countershaft having two speeds in this case. The figures 17.8 below these symbols show that instead of getting exactly 17 feet circumferential speed, as called for, the speed given by this combination of pulleys and gears is in reality 17.8 feet per minute. The division at the left of the arrow head shows that, should the next slower speed be used, the surface speed of the work will be 14.3 feet per minute.

When sold for these special applications the instrument has the outer circle left blank, the purchaser supplying the divisions on this circle. This, however, involves nothing more than counting the speeds which the various combinations of pulleys and gears give, filling in the lines and then varnishing the disk with shellac.

For assistance in keeping the speed division while setting the diameter division against it, a celluloid radial index is provided, but this is not shown in the illustrations.

As anyone can use the instrument, one may profitably be hung alongside each lathe—and for this a hole is provided. With such an instrument at hand, there need be no excuse for any lathesman running his machine at an improper speed.

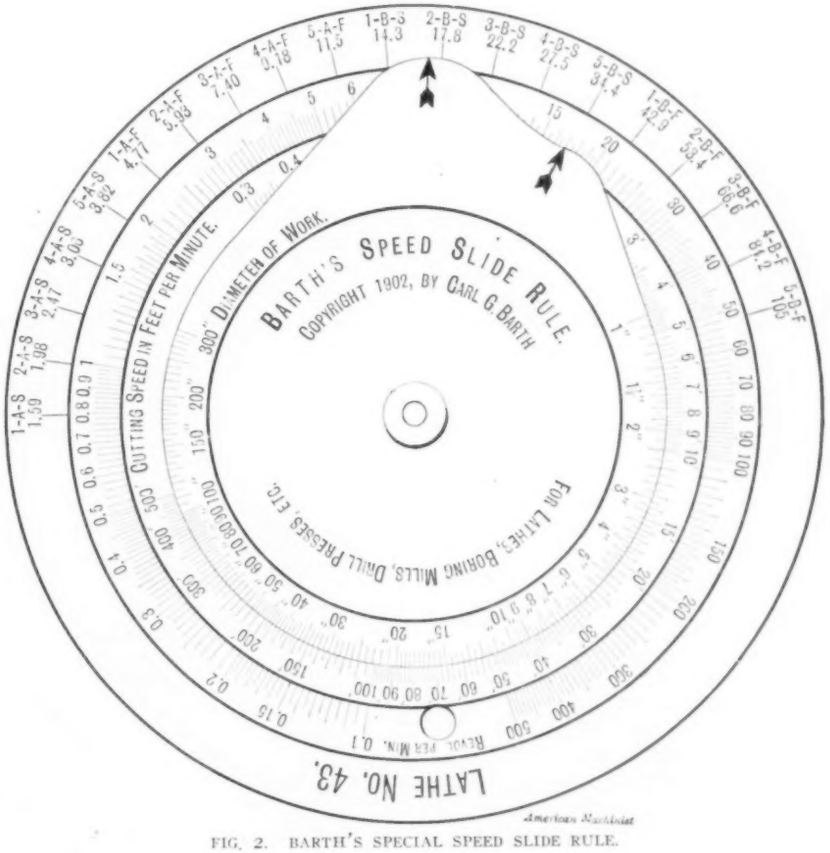

BARTH'S SPEED SLIDE RULE.
COPYRIGHT 1902, BY CARL G. BARTH
FOR LATHES, BORING MILLS, DRILL PRESSES, ETC.
300" DIAMETER OF WORK.
CUTTING SPEED IN FEET PER MINUTE.
LATHE NO. 43.
American Machinist

FIG. 2. BARTH'S SPECIAL SPEED SLIDE RULE.

Letters From Practical Men.

Jobbing and Manufacturing in the Same Shop.

Editor American Machinist:

The questions of Junior Boss, at page 1458, have probably caused more anxiety to managers of shops doing both manufacturing and jobbing work than all others combined. I doubt whether Mr. Osborne would say "throw up the manufacturing," as every man with experience in the jobbing business knows there are times when practically every man in the shop would be sitting on the bench waiting for a job, but for the fact that some manufacturing work is done, and in order to have ends meet the jobbing rate would be so high as to absolutely drive away customers.

The Simon pure job shop, where the proprietor is a mechanic and works himself with the assistance of three or four men, may be made to pay; but for a shop employing over ten men to run on jobbing alone and pay, the management or conditions must be exceptional. Taking it for granted that jobbing and manufacturing must both be done, let us see how we can best combine them. If the shop burden is 50 per cent. of the applied labor and Jones' rate is 25 cents per hour, 37½ cents per hour will represent the labor cost of such manufacturing work as Jones may do, but if we only charge 37½ cents for Jones' time when coaxing a balky gas engine, it is evident that we are donating his services, or, at least, selling our goods at cost. If, however, we charge 50 cents per hour, we are selling at a profit of 33⅓ per cent., which will probably cover the "know how" in most cases. If instead of one man we have ten and the average rate is, as before, 25 cents, a uniform rate of 50 cents for job work will be all right, provided we are careful not to send out the high-priced men too much; but is this flat rate the fairest way for either the shop or the customer? If a cheap man be sent out the customer pays too much, and if a high-priced man the shop receives too little. If a flat charge of 100 per cent. pays expenses and a fair profit, a much more equitable way would be to charge 40 cents for a 20-cent man and 60 cents for a 30-cent man, and should the customer kick on the high rate, send a cheap man next time and that will settle it. Junior Boss says: "Unfortunately, we do not get any chance (and it is, I suppose, the fault of the engineers themselves) to charge a bit for knowing how to do a job. We do not get paid for advice like doctors and lawyers."

Engineers here means proprietors or managers of shops doing jobbing and contract work. Who of us in this line does not realize the truth of that remark? Who of us does not know the fellow who comes around with a few lines on a piece of wrapping paper or a couple of sticks and a piece of twisted wire, and wants a complicated machine constructed around that nucleus? We want to do his work and so do not tell him, as we should, to first get his ideas in intelligible shape on paper. From the data at hand we cannot make him a price on the job and so take it by the hour, and after much "cut and try" and many changes the machine is completed and has cost the customer 50 per cent. more than it would had he furnished drawings, and we are out a lot of time, thought and material, which we cannot include in our bill. Nor is this the only evil, as, by taking on ourselves the designing and drawing or their equivalent, we take this away from someone who is trying to make a living that way and drive him to starting a shop in competition with us and thus work further injury to our business. If the shop employs a draftsman who has time to do this work and the customer will pay for it, well and good, but in any event the sooner shop men refuse to undertake the construction of such machinery without full detail drawings the better for all concerned.

I cannot agree that this mixing of jobbing and manufacturing "precludes the possibility of standardizing or adopting repetition methods."

I recently installed a shop order and cost system in a shop employing upward of 200 men, where business was about equally divided between jobbing, contract work and straight manufacturing, and subsequently superintended the design and construction of jigs and fixtures for standardizing and making interchangeable parts of several of their regular machines with the result of a reduction in labor cost of from 25 to 33⅓ per cent. If the parts are not carried through in too large lots there will be no difficulty in carrying on standard manufacturing and general jobbing in the same shop without detriment to the manufacturing end. Jones, when in the shop, will be employed on assembling work and when called out all time from the moment he drops this work till he takes it up again should be paid for by the customer.

S. L. Bley.

The Modern Method of Drawing Sheet Metal Shells.

Editor American Machinist:

At page 1338 Mr. Woodworth shows a set of tools for drawing long copper shells. I fail to see why the tools were made as shown.

Figs. 1, 2 and 3 show three ways of making a set of cupping tools, to produce a sheet metal shell in one operation, as at present in common use in the large brass shops in the East. Fig. 4 is an ordinary redraw die. The difference between a redraw die and a reducing die is that in the redraw die the whole shell is reduced, and in the reducing die part of the shell is left the original size, and in some cases expanded at the bottom, as in some cartridge work.

Quite a difference will be noticed between Mr. Woodworth's tools and ours. Where Mr. Woodworth uses wrought iron we use cast iron; where he makes a job for the blacksmith we make one for the foundry, and save money. *A*, Figs. 1 and 2, is provided in about four sizes. *E*, Fig. 1, is a cast-iron punch block of which we have four sizes. *B*, Fig. 2, likewise is a cast-iron punch-holder of which we have four sizes. Between the smallest of those shown in Fig. 1 and the largest of Fig. 2 we are able to do work of the smallest and largest that we have as yet been called on to do.

The dies *D*, Figs. 1 and 2, are tool steel, hardened, ground and lapped, after being turned and bored as shown. The outer edge is turned to 2½ degrees taper to fit the die beds, ring gages being provided o make this fit. *c—d*, Figs. 1, 2 and 4, is the cutting edge and blank-holding surface. It will be noticed that the bottom corner *i* of the cutting edge is cleared from the blank-holding surface; this is done so that the two may be ground after hardening, and not leave a round corner for the metal to pinch on. The drawing punch E, Fig. 2, is tool steel, hardened and ground, after being threaded at *K* for the extension that we use so as not to make too long a punch. We have a variety of lengths and sizes which we use on large work. The blank holder *C*, Fig. 2, is tool steel left soft, and is fitted to *B* at *F* with a slight taper, being held in place by four screws.

The die, Fig. 2, is a drive fit, and is prevented from pulling up by the stripper plate and gages (not shown) held by four screws in the tapped holes. The die shown in Fig. 1 is used for all work up to about 2 inches diameter. The die *D*, being a taper fit as in Fig. 2, is held down by machinery-steel plate *B*, which is held by four flat-head screws. The blank-holder *b*, Fig. 1, is tool steel left soft, and fitted into the punch block *E* with 2½-degree taper. No other fastening is needed, for the working strain is all the one way, against the shoulder and punch-block. The drawing punch is made as in Fig. 2, and is held in place by a U-shaped piece fitting into groove *b*, Fig. 1, and a slot provided in the ram of the press.

Fig. 3 is another construction that has some advantages over the others, as it permits us to remove the die *B* without disturbing the setting of the cast-iron bed *A*.

The die *B* is the same as the others, except that the outer edge is tapered the reverse way about 20 degrees. The cast-iron die-bed *A* is threaded to fit the machine-steel ring *C*, which fits the taper of die *B*, being tightened by a spanner in the small holes *a*. In this construction it is only necessary, in order to remove the die for repairs, to loosen ring *C*, thus saving the resetting of the tools.

Fig. 4 is an ordinary redraw die of tool steel, hardened, ground and lapped to a dead smooth surface. It will be noticed here that the extra plate which Mr.

Woodworth uses is not shown. Instead of this, in all cases where tools are not used on automatic feeds, we recess the top of the die to fit the body of the shell to be redrawn.

The punch *B* is held by shank *C* turned to fit a standard holder, of which we have a variety of sizes, and is held against the shoulder and at the same time prevented from pulling out by a flat filed with an incline, as shown.

It will be noticed that the lower stripper edges of the dies *D* are slightly chamfered (see *e*, Figs. 1, 2 and 4); this is to prevent them from chipping off and prolongs the life of the die beyond what it would otherwise be, as they are left as hard as fire and water will make them.

It will be noticed also that all the drawing punches are provided with air vents, *a* and *b*, Figs. 1, 2 and 4. No first-class drawing work can be done without allowing the air to escape from between the metal and punch.

In all cases of straight work the shell is pushed directly through and stripped by the die, so that no extra strippers are needed as in Mr. Woodworth's tools, thus saving time and money. I hardly understand why Mr. Woodworth brings his shells back through the die. I fail to see why his shells could not have been treated thus, unless he had trouble in stripping the copper, as is sometimes the case when tools are not properly made.

By the use of cast-iron die-beds and punch-holders the first cost is reduced, and after they are made, all that is necessary is to provide the steel parts to fit them, thus saving quite an amount in a short time.

I do not believe there is a large brass shop in the East that makes tools as Mr. Woodworth has shown them. I have noticed such tools in the scrap pile, but never in actual use, as they are out of date.

I have found that the trouble with most men is that they seem to think that all there is to a drawing die is to get a hole through a piece of steel, and round off the top edge and it will go, when, as a matter of fact, the tool must be made right or the work will not be satisfactory. Some men spoil good tools in the setting of them, by not getting an even pressure on the blank. The shell is one sided, and also at times causes the cutting edge to shear.

By making our dies of tool steel, we can readily shrink them as they enlarge from use, and I hardly think cast-iron ones will fill the bill in that respect.

Mr. Woodworth has a good word to say for the toggle press; for my part, I prefer a good, stiff cam press. I find that we can keep our tools in better shape with them than with the other style, owing to the tendency to shear in the toggle construction. We use the cam in preference to the toggle when possible to do so.

I have not attempted to show tools for any particular job, for the construction is the same in most cases, except in the reducing dies, when we have to be governed by circumstances. Neither do I claim to be the designer, as they are an evolution of the needs of a large factory doing a variety of work.

EXPERIENCE.

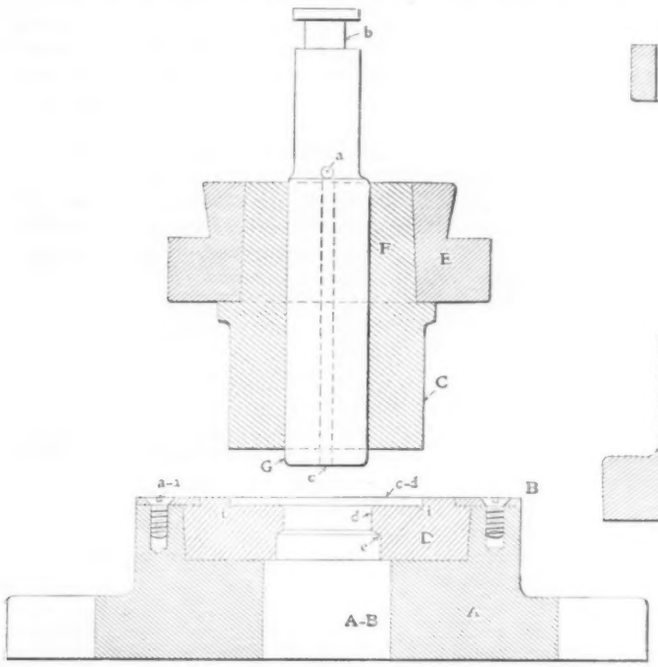


FIG. 1

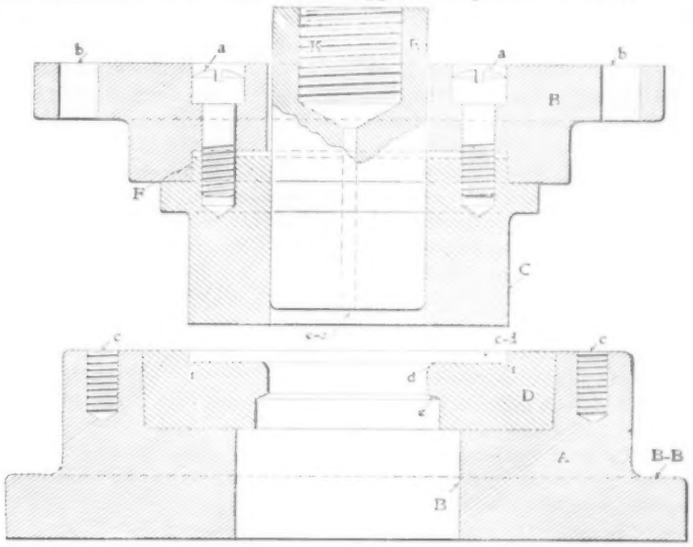


FIG. 2

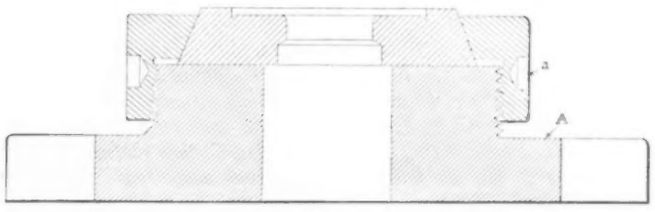


FIG. 3

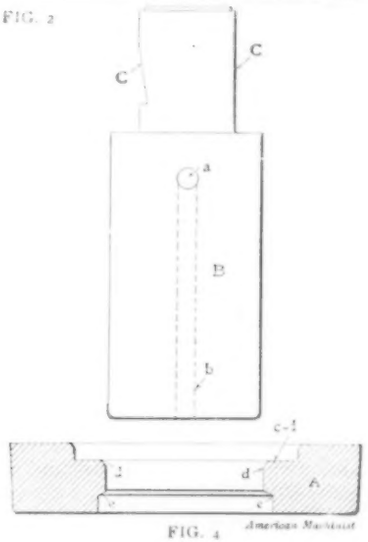


FIG. 4

MODERN SHELL DRAWING DIES.

Taxing Patents.

Editor American Machinist:

In view of the articles, "Interesting Facts from the Patent Office," at page

1332, and "Taxing Patents," at page 1519, I submit the following suggestion: Let us have a law that will do justice to the inventor who is with or without great means and also tend to stimulate new invention. It seems to me that taxing patents at too short an interval would be very hard on certain inventors; and not to tax patents at all does great injustice and injury and lessens the ambition of many inventors, and, as a consequence, the greatest good to the greatest number suffers. Therefore I suggest a law fixing the natural life of all patents, at what is, perhaps, a more reasonable term—say, ten years.

At the end of that time all patents that are "sleeping' die naturally and become "old lumber," literally. Those, however, that are alive and in practical use could be given a new lease of life on the payment of a nominal fee—say, from $10 to $25. This fee could be used to publish lists of the "lumber' as it piles up. Such lists, properly classified, would make excellent indexes for reference.

H. J. EBERHARDT.

[The difference between our suggestion and Mr. Eberhardt's is one of degree only. We urged the imposition of a fee of $5 at the end of each five years, while he urges a fee of $25 at the end of ten years. We think his period too long and his tax too high. Ten years is a long time for the owner of a worthless patent to hold a potential club over the head of an inventor who has put value into his invention by inventing a feature which makes it practicable.—Ed.]

Roller Bearings.

Editor American Machinist:

Having up to a short time ago made some thousands of roller bearings for various purposes, I am led to add myself to the list of your correspondents on the subject.

In the manufacture of what we call a first-class bearing for railway or tramway work, the rollers—1⅜ to ¾ inch diameter, according to requirements—were case hardened and ground to size; the cages were gun metal bored 1-16 inch larger than axle, turned 1-16 inch smaller than case and machined to receive the rollers. The cases were cast steel, bored 5-1,000 larger than diameters of axle and rollers. A pin-hole in the crown of the case was sufficient to cause dubious looks from the inspector; two ditto twinged his conscience more or less, according to their size and position, but three gave him no anxiety whatever, being thrown out promptly from a sense of duty which I can appreciate better now than then.

Latterly cast-steel liners were forced into the cases, an improvement in several ways: (1) Less loss from blow-holes in cases; (2) ability to turn liner around in the case to avoid pin-holes coming on top side of bore, and also (3) to bring a fresh wearing surface to the top when old surface was worn, and (4) easily renewable when worn out.

For a cheap bearing to be used on small trucks the rollers—⅝ to 5-16 inch diameter—were of bright drawn compressed steel, cut off to length in the automatic. The cages were gun metal, bored and turned as above but not machined for rollers, and the cases were of hard cast iron.

Like most lines of manufacture, we had our share of repairs, and here is just where hopes are shattered and instruction begins. Of course, even a worn-out bearing does not appeal to everyone in the same way, and many engineers may differ from the opinions which such bearings have left with me. So I will only say that, for my own part, I should not use roller bearings for any kind of reciprocating motion (you should have seen the horrible results on an engine in which they were tried); nor would I use them on any wagon running on a track with many sharp curves, unless the bearing were provided with swivel liners to provide greater elasticity. In almost all cases where the motion is in a constant direction, the axle or shaft is not subject to severe shocks, and where the length of bearing is restricted, well-designed roller bearings are splendid.

The shafting pedestals of the old fixed type roller bearings show a remarkable saving in power, but unless the shaft is provided with sleeves to form a path for the rollers it soon gets badly worn—a costly matter. So that, combining cost with efficiency, I should prefer to use for shafting a long, plain, adjustable pedestal rather than the rollers.

The subject is interesting, and I suppose none of us have exhausted it.

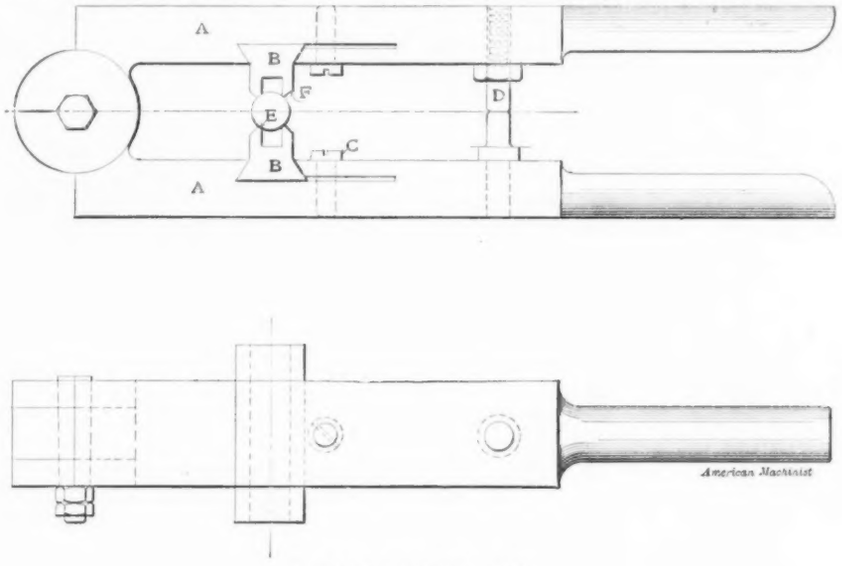
Peterboro, England. ROBT. TRUE.

A Hand Finishing Tool.

Editor American Machinist:

The accompanying sketch shows a tool for finishing small shafts or bearings which are first roughed in a lathe and have about 0.005 inch to be taken off with the finishing tool. This tool has proved a great time saver on work in large quantities because it not only makes a perfectly round and smooth finish, but it finishes the work about five times as fast as it could be filed.

The tool holders *A* are fitted together, as shown, with a taper pin and a pair of check-nuts for adjustment. The cutters *B* are made dovetailed and held in the holder with the screws *C*, and the stop *D* can be adjusted for sizing the work. The cutters are planed up, hardened and placed in the holder, and then lapped with a lap the size of the work to be finished, until they have a lapped surface about 3-32 inch wide at *E*; then they are ground on the four sides *F*, and the tool is ready for use. ADAM HERKNER.



A HAND FINISHING TOOL.

A Method of Filing and Indexing.

Editor American Machinist:

At page 1454 "A Constant Reader" brings up the need of an index of valuable suggestions in periodical literature. I experienced the same difficulty for years and tried various systems, the card index included, but the trouble grew till about two years ago, when I adopted an envelope system which has been very satisfactory. I now have about 600 envelopes with perhaps 3,000 articles in workable condition. The work of arrangement was considerable at first, as I had about ten years' accumulation of clippings from engineering magazines, but now about three hours once a month keeps it going.

My equipment consists of an oak case made to order containing 12 drawers and having a capacity for about 1,200 envelopes, the cost of which $10; envelopes, size 6½x10, common manilla, cost 90 cents per 1,000; white cardboard cards, 3x5, cost about $1 per 1,000.

The method of operation is to tear out the leaves containing articles that I think will prove of value. These I fold once

and drop into a drawer in the case set aside for this purpose. As I find time, these sheets are taken out and the articles are scanned for a general idea of subject matter, and if, as is frequently the case, two or more articles are found that should be indexed, I select the one that I think most likely to be looked for or a continued article, as, for instance, the one published at page 1224 on "Elevator Safety Appliances." I then select the envelope marked "Elevator Machinery" in order in the *E* drawer. Under this general title on the envelope I write in pencil "Safety Appliances. Baxter." I take out the sheets of the preceding articles of this series and fold the new article within the old ones, no entry of the present article being necessary. On each of the other envelopes under the general head of "Elevators," as grain, passenger, etc., is written in the left-hand corner—"Note: See also elevator machinery."

To index the article by Mr. Guy—"The Strength of an Egg Shell"—which is partly printed on the sheets containing the elevator article, I take out the envelope marked "Tests, Misc.," and inside this I find a card partly filled out on which I enter "Eggs, Strength of. Guy. See Elevator Machinery Safety. Baxter." To show that the article has been cross-indexed I check with pencil over the word "Test" written in pencil at the head of the article. If there were an envelope on "Eggs" in the file, another check would be made over "Eggs" in the title with a cross-index on a card in the "Egg" envelope.

The advantage of this system is th little time taken to work it. There is no need of trimming the article, very little writing, and no summary. Similar matter can be placed together, single articles can be taken out and used or loaned, the meat of all one's technical reading is together and obsolete matter can be easily discarded. The disadvantage is the impossibility of referring to magazines for articles that have not been saved, but by being liberal with the selections this does not often happen. C. J. M.

The Need of Investigations of the Power Required to Drive Machine Tools.

Editor American Machinist:

We note with great interest the article at page 1334 of the AMERICAN MACHINIST on drilling cast iron from the solid. These tests, together with the graphical method of presenting the data, are certainly along the right lines and at once form a starting point for the designing of machine tools to operate twist drills in cast iron.

About a year ago we called attention in your columns to the absurd design of most drilling machines, particularly of the gang type, showing how inadequate the power was found to be in every case. The feeds were not only too few but too small, and the general design of the machines such that lack of rigidity prohibited running to the limit. How different the results would have been if these tools had been designed from data such as have been obtained by the Bickford Drill & Tool Company, and how else can the results be arrived at?

The same general plan should be followed whether designing a sensitive drill press or a 60-foot boring mill. The general requirements, such as character of work, finish desired, means for clamping, etc., must be thoroughly studied, and then from data regarding the tool steel used and material to be machined the various details of the tool should be evolved. For instance, the number of spindle speeds should be based upon the uniformity of our tool steel and material we are working, and the depth of cut and feed that the work will permit of, fix at once the power and rigidity required, if the relations between these quantities are understood.

Does it not seem strange and inconsistent that we should suddenly find that we can quadruple the feeds on our standard twist drills, and that under such conditions the intervals between grindings are sufficiently long to make such operation thoroughly practical?

The inability of the average machine tool to run up to the destructive limit of air-hardening tools treated by the new processes which have recently been developed is not remarkable when we realize how vastly the efficiency of the steel for roughing work has been increased, but it does seem strange that exact knowledge concerning the operation of twist drills should be as scarce as we would infer from the above statement.

We are perfectly aware that the development of the motor has vastly facilitated—we might say, made practically possible—the work of obtaining an accurate measurement of the horse-power required for varying conditions; and as tool steel has become more uniform in character it is much easier to obtain definite knowledge with regard to its capabilities. We feel that the time for action has arrived, and the least we can expect of the machine-tool builders is to take immediate advantage of the great opportunties that are now open to them, and design tools that will do the work for which they are intended at the highest possible efficiency. Study the requirements first and then design for a given duty.

During the past three years we have been actively engaged upon this problem of shop efficiency and upon every turn have been astonished at the inability of the average machine tool to operate the tool steel at anything like its maximum efficiency. If we analyze the problem for a moment, taking the lathe as an example, we think we can show that our claim is just.

Referring to the catalogs of several well-known makes of lathes, we find that the requirements that are of first interest to the customer, namely, swing and center distance, are always clearly stated, while the next point to be considered is the capability of the machine to do the work rapidly, which is nearly always ignored. We hear lots of talk about steel gears, great power, heavy feeds, etc., but only in a general way. It means nothing. Do we ever see in the catalogs statements as to available horse-power at the tool post for different positions of the belt?

In comparing the horse-power at different belt speeds for lathes of various sizes and makes, we find that as an average a lathe with 14-inch swing has .4 to 1 horse-power delivered to it when the belt is on the largest and smallest steps of the cone respectively, while for a 42-inch lathe these figures become 2.5 to 6.25 horse-power, or lathes of three times the swing have about six times the available horse-power.

If anyone has data to justify this relation between swing and horse-power, it has not come to our notice as yet. All our experience has gone to prove that it is utterly false, and although we will admit that work of small diameter does not as a rule permit of such heavy cuts as large pieces, the difference is in no such proportion as the builders assume. In the works of the Link Belt Engineering Company, the work is of a very general character, the vast bulk of it being cast iron. Their experience has proved that in many instances it is possible to absorb more power at the tool on small work than large, as it is easier to hold the work, the consequence being that a 48-inch lathe equipped with a motor varying from 6 to 18 horse-power is working a large part of the time on castings under 18 inches diameter. And why should the conditions be otherwise as the amount of metal to be removed, the feed and speed, are approximately the same?

When we examine in detail the majority of machines on the market for doing roughing work where multiple cutters are used, the lack of power and rigidity are more forcibly brought out.

The reason that the subject has been given such a small amount of study in the past is because the customer of such tools is as ignorant of their possibilities as the manufacturer, and for years has been adapting his work to the belt. Although "production to the power limit" was a big step forward, the manufacturer is rapidly learning that it is the *tool limit* that he must look to as the final limitation of his output.

It is all resolved down to one thing, viz., a thorough knowledge of the relations existing between speed, feed and depth of cut for different materials and tool steels. The uniformity of the material we are machining, and also the tool steel, the best angles to grind the tools and innumerable details which suggest themselves as essential if an accurate and scientific design is sought.

We do not wish to go on record as making any rash statements as to what can or cannot be done, as we have not as yet, except in special cases, the data to base

such statements on. We do, however, urge that the machine-tool builders follow out a line of experiments, as has been done by the Bickford Drill & Tool Company, not being satisfied by a few experiments, but continuing the work and so ultimately be in a position to say that such and such a tool will do just so much work; and the customer in turn will order, for example, a lathe to pull a cut ⅜x⅛ inch at 75 feet per minute, the material to be machined being 50 carbon steel, the character of the work, variation of diameter, finish desired, etc., all being considered when making the purchase. We fully realize that it would not be advisable to make special tools for each case, but we are convinced that in most cases the *average* conditions are not sufficiently understood, the majority of machines handling the work in a *most inefficient* way. DODGE AND DAY.

[The question of proportioning a motor to a lathe is by no means so simple as it appears. We recently learned of some readings taken from a 48-inch lathe in which the power required to drive the empty lathe at its highest speed exceeded by several times the power required to drive it at slow speed with a heavy cut and a diameter of work appropriate to the speed. The power absorbed by the friction of the machine is necessarily a much larger proportion of the total power with large tools than with light ones, which fact, combined with the action noted above, makes it obvious that there is here a field for experimental work which badly needs to be occupied.—Ed.]

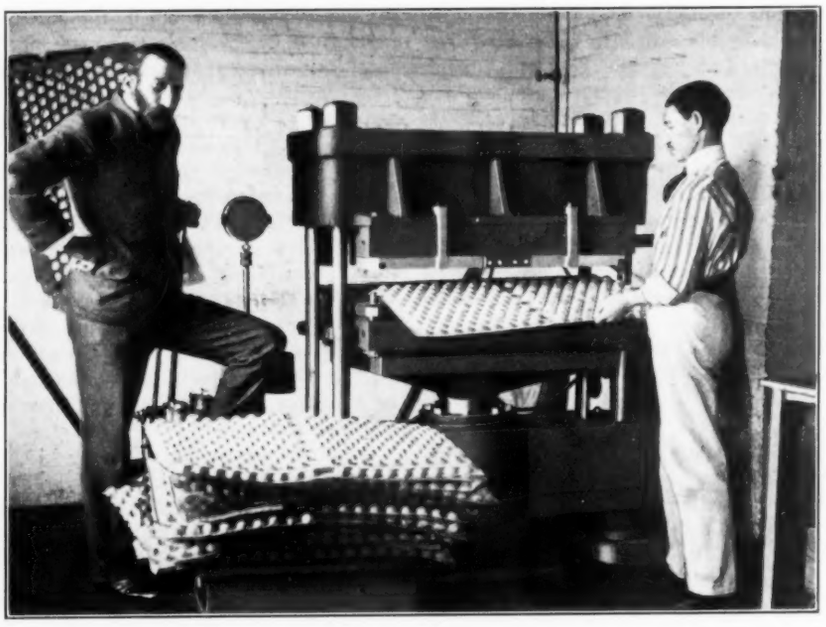
American Manufacture of Ping Pong Balls.

Editor American Machinist:

At page 771 was an article, entitled "British Triumph," referring to the making of ping pong balls, which was taken from the *London Graphic*. The said article was quite sarcastic, claiming a victory for the British, and saying that the Americans could make almost everything except a ping pong ball. In the same issue the AMERICAN MACHINIST said that there were about one hundred patents issued in the United States on golf balls, and suggested that by the time there were a hundred patents on ping pong balls the American ball might be as good as the English.

Up to the present only one American inventor has challenged the British in making ping pong balls. From the picture, Fig. 1, it may be seen that the first man who began to file patents is already embossing 220 half-balls in one operation in less than two minutes' time, while the English are embossing their balls one by one. According to this, 60,000 half-shells are embossed every ten hours. That means a daily output of 30,000 balls through one press alone.

This is not the best we can do as yet, so says Mr. John Whitehouse, the inventor of this process. At the time he started to make ping pong balls he had made himself acquainted with every conceivable means for stretching celluloid, which indeed is a very peculiar material. The male and female die is the first thing a person will think of, but owing to the fact that celluloid will not draw into a die like any metal will, but, on the contrary, that it has to be held firmly and the embossment stretched out of the thickness of the material, naturally, if a sheet of celluloid is taken, say, 1-100 inch thick, and a half-shell of a ping pong ball is embossed of the same, if it cannot draw in (as it will not) through the stretching the celluloid will take a variety of thicknesses. The bottom of the half-shell in the die will be much thinner than its sides. Owing to this fact it is very expensive to make a male and female die that will have the proper clearance according to the stretch of the material. It has been found that a metal female die and a male die made of paper work quite satisfactorily, by reason of the elasticity of the latter, if both are heated to about steam temperature.



EMBOSSING PING PONG BALLS.

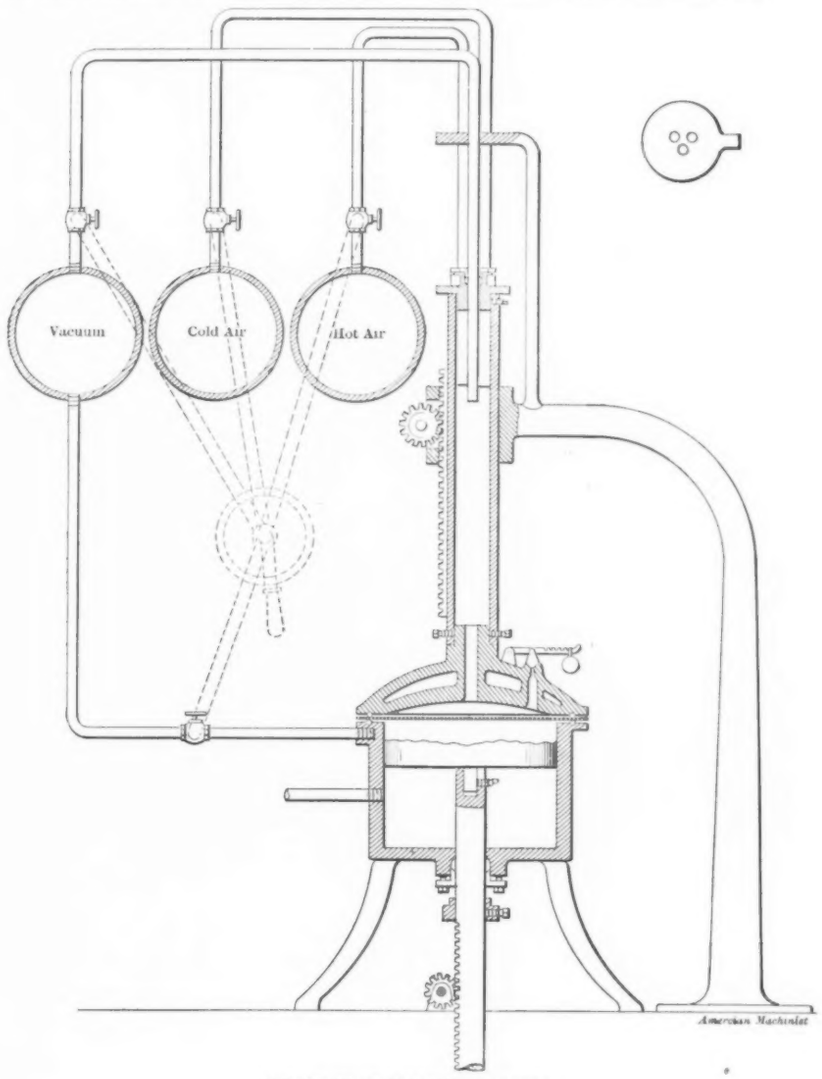
This is the method shown in the above picture. An entire sheet of celluloid is taken and placed in the machine and 220 half-shells are the result per operation. This is over one hundred times as fast in making ping pong embossments as that of our English friends. Yet this American inventor is anything but satisfied by being one hundred times as fast as the English. He says that soon he will have metal male and female dies, and he will then be able to produce these goods ever so much faster, for the reason that metal will heat ever so much faster than paper will, as after each operation both the male and the female die have to be cooled while under pressure, or otherwise the hot celluloid would shrink out of shape. The reason that it does take two minutes to make one embossment of 220 half-shells is because paper is a non-conductor of heat, and for that reason is slow in heating and cooling.

The only thing left to do, says Mr. Whitehouse, was to devise some means through which a metal male and female die could be made in an inexpensive way, which he says is as follows. He makes his cast-iron female die as usual and secures a sheet of flexible rubber equal in thickness to that of the celluloid to be embossed over the die, which then is placed in an electrolytic copper bath. The tank which contains the copper solution has a cover which is closed, and an air pressure of 50 pounds per square inch is produced therein. The solution under pressure will force and stretch the rubber into the female die and keep the rubber there until a deposition of copper of about ⅛ inch in thickness takes place. As rubber will stretch exactly the same as celluloid does when heated, the above mentioned necessary clearance according to the stretch of the material is hereby secured, and the method of embossing as the result is much faster than with the male and the female die when the former is made of paper.

The inventor is not fully satisfied with the result obtainable from a metal male and female die. In a short time he will build a large machine through which he will be able to emboss as many as 250,000 half-shells per day. When embossing an entire sheet of celluloid in one operation quite a number of difficulties have to be overcome. If a sheet of celluloid is placed over a die so that the air is enclosed in each of the cavities and becomes hermetically sealed therein with the celluloid, it is quite hard to get rid of the same.

The accompanying outline sketch, Fig. 2, of the air machine shows how it will

operate. The celluloid is held in a frame by its edges and becomes a diaphragm, and as such it is placed over the die and is held on a packing ring. The female die is vertically movable and is lowered away from the diaphragm of celluloid to be embossed. The air is exhausted from the female die and it is then brought back to its original position to be in contact with the celluloid. In this way a partial vacuum takes place in the die. The upper half of the machine is brought down on the celluloid and through a packing ring it is hermetically sealed on its outer edge. It is now ready to be embossed. Compressed air at a temperature of about 220 degrees Fahr. and with a pressure of 100 pounds per square inch is admitted. The celluloid through the heat and pressure instantly stretches into all the cavities, no matter how deep.



CELLULOID EMBOSSING PROCESS.

It is claimed that with this method celluloid of only 1-100 inch thick can be embossed to a depth of from 5 to 7 inches. The peculiarity of celluloid is that if the same is not cooled under pressure while in the die it will shrink considerably. To this end, while the pressure is kept up by the compressed air the same is rapidly cooled through a circulating stream of cold air or water. The whole operation takes place in about 30 seconds. The vacuum pump almost instantly produces the vacuum in the female die. The hot compressed air (which is connected to the male die) almost instantly performs the embossment. The jet of cold water (or cold air) quickly performs the cooling. After all this the finished embossment is taken out and replaced with a new sheet to be embossed.

This machine will not only make ping pong balls at an enormous speed, but it will emboss designs and figures of every kind, and the most beautiful work in the line of embossments can be readily performed on this machine at a very low price. Considering that celluloid always retains its high polish, no matter how deeply embossed, the most intricate work with the sharpest of corners and the minutest of detail can be performed, even if there should be undercuts on the picture or design.

This is only the beginning of the products of one inventor who has started in to challenge the British. He is not satisfied with being able to turn out 100,000 ping pong balls daily with one machine. How about the other ninety-nine inventors? JOSEPH MISKO.

A Little Knowledge.

Editor American Machinist:

"Don't think I shall take the AMERICAN MACHINIST next year," said one of my bright young friends the other day. I asked why not—for he had been a reader for years—and he told me rather an interesting story of conditions where he happened to be employed.

"Last year the 'super' turned over a new leaf; had been reading of the 'suggestion' game that they play at the National Cash Register place and other shops, and he thought it was just the thing. So he tacked up boxes around the shop—same kind they have for mission contributions to buy overcoats for the Hottentots—and advised us all to take at least one good mechanical paper and to make suggestions freely. We were to just consider we had a strong interest in the welfare of the business and jot down anything we thought would help the quality of the output.

"Most of the boys are pretty bright mechanics, and, as you know, we had a good chance there to make suggestions with our eyes shut, as the shops never had been progressive. The way those boxes filled up with suggestions was a caution, and there were but mighty few fool ideas in the bunch either, and they were mostly mine.

"The Old Man couldn't have followed all of them out in a year if he'd done nothing else, but instead of sorting out the best ones, those for which there was a crying need every time you looked into the shop, he got rattled at the number and thought we were trying to have fun with him or to make it look as though he didn't know his business. So he decided the suggestion scheme was only 'a fad of the high-falutin shops that make more money than they know what to do with,' and he dumped the whole batch in the stove. We all had visions of being begged to take the position of assistant superintendent, owing to our valuable suggestions and the interest shown in the business, etc., but these vanished into thin air when we heard of the cremation and saw the bulletin next day.

"'As every man in the shop appears to think he knows how to run it better than the superintendent and believes he can improve everything in it, the request for suggestions is withdrawn, it having degenerated into an opportunity for criticism. I regret having encouraged the reading of mechanical papers, as they prove that a little knowledge is a dangerous thing.'

"'SUPERINTENDENT.'"

The fellows in the shop naturally got the idea that he was not so anxious to improve after all, and as a matter of fact he didn't. R. H. JACKSON.

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Shipping Facilities Curtailed.

One result of the combinations that have been going on among the railroads is that manufacturers of machine tools and other shippers of freight from Cincinnati find themselves deprived of some of the facilities formerly enjoyed by them. It is noticed that whereas formerly tool builders there were often solicited for business by representatives of the different roads entering that city, now, as some of the builders express it, "we have to go to the roads and almost beg them to take our freight."

Formerly it had been the custom for several builders to unite in making up a carload lot of machinery to be shipped to New York or other distributing point, but recently this privilege has been withdrawn and now any one builder must in order to secure carload rates actually prove the ownership of every machine comprised in the carload.

Recently, too, the rule has been adopted of closing the freight stations at 4.30 P. M. instead of 5 P. M. and at noon instead of 1 P. M. on Saturdays, as was formerly the custom, thus curtailing the time within which freight shipments will be received and causing many shipmerts to be held over an entire day later than would formerly have been the case.

One of the advantages that Cincinnati has enjoyed and that has contributed very much to her prosperity as a machine-tool center has been good shipping facilities. It now seems as though this advantage is likely to be in some degree curtailed unless a remedy is found. While the railroads may claim to have made Cincinnati, Cincinnati may with equal justice claim to have made the roads, and Cincinnati manufacturers believe, not unreasonably we think, that the roads should recognize the mutual obligation, even though they have things fixed so that they need no longer conduct their business upon a competitive basis.

Wages Advance.

It is announced that the Pennsylvania Railroad has ordered an increase of 10 per cent. in the wages of all its employees —about 105,000—who earn less than $200 a month. In recommending this increase, President Cassatt is reported as follows:

"The country is passing through an unexampled period of prosperity, and, as far as the Pennsylvania is concerned, this prosperity is bound to continue for at least two years, if contracts are kept. It is time that our employees be given a share in this prosperity. All the railroads in the United States and all employers of labor are contemplating an advance in wages. The cost of living has increased 20 to 25 per cent., but wages have not increased accordingly. This movement is bound to come, and the Pennsylvania may as well lead as follow. We have more business offered than we can handle, and can't see our way out of the trouble unless we keep our men loyal to the company and help them while they help us. I, therefore, recommend a flat increase of 10 per cent. in wages, and advise that this announcement be made to the employees first and to the public later."

The example of the Pennsylvania is being immediately followed by the Reading, the Baltimore & Ohio and other roads

The English and the American Standard Yard.

At page 1558 our English correspondent, Mr. W. H. Booth, stated that the American standard yard "is a very small fraction of an inch longer than the English standard" and that "the difference is quite sufficient to be measurable when it comes to a comparison of two 4-inch gages made on the two standards."

As this was news to us, we referred the matter to the Pratt & Whitney Company and to the Brown & Sharpe Manufacturing Company. Following are the replies:

"Would say that there is *no* difference between the lengths of the yard standard in the United States and the Imperial yard, or Bronze 1, except as may be due to the known relation at 62 degrees Fahr. and determined by comparisons under the prescribed conditions.

"Bronze 11, at Washington, is a copy of the Imperial yard as nearly as could be made, and hence no perceptible difference should exist even at the limit of 36 inches, certainly not at 4 inches.

"GEO. M. BOND."

"The facts in the case are that we have absolutely no difference at all, as whatever comparing is done in this country, the figures furnished are in the terms of the true English standard of England; so that we know of no standard but *the* English standard. BROWN & SHARPE MFG. CO."

"The Engineering Record" Changes Ownership.

Announcement is made in *The Engineering Record* for November 15 that it has been sold to Mr. J. H. McGraw, the owner of the controlling interest in *The Electrical World and Engineer, The Street Railway Journal* and *The American Electrician.*

The Engineering Record was established twenty-five years ago by Mr. H. C. Meyer, who has conducted it continuously. Its original name was *The Sanitary Engineer,* and while its field has been broadened with its change of name to include the work of civil engineering, it has never lost its original distinctive character, as it has always devoted especial attention to building construction, heating, drainage, plumbing, etc., as well as to sanitation in a large sense.

The paper is, as it always has been, a representative of the best in technical journalism. No technical journal has had our more cordial respect and our respect for Mr. Meyer as a publisher has been upon the same plane. We wish there were more like him and we regret to see him withdraw from the publishers' ranks. The

editorial management will be unchanged, and Mr. McGraw's reputation as a publisher insures the paper's continuance upon its old plane of excellence.

Some New Things.

A NEW CHUCK.

The cuts show a chuck, for use in the drill press or the lathe, which is so arranged that drills, taps, counterbores, etc., can be instantly changed and without stopping the machine. The chuck consists of a socket *A* drilled out at opposite sides for two steel balls, a locking ring or collar *B*, which fits loosely on the socket, and a sleeve or collet *C* fitting easily in the bore of the chuck. The collet *C* is provided with two grooves, as shown in Fig. 2, which come opposite the holes drilled in the socket, and when the ring *B* is slipped over the

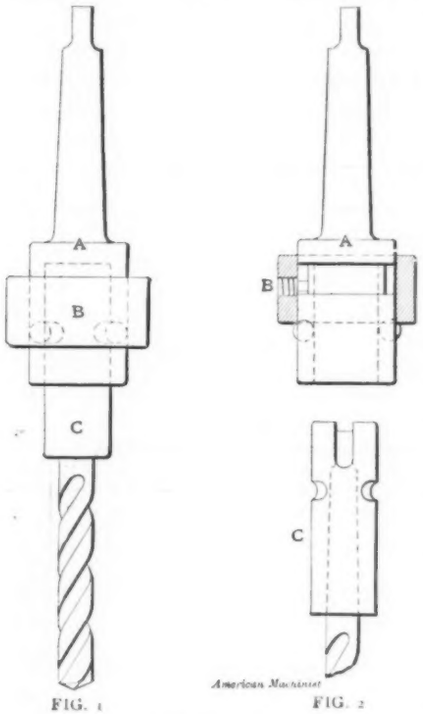

FIG. 1 FIG. 2

NEW CHUCK.

balls, as in Fig. 1, they are forced into these grooves and hold in place and drive the collet. The holes in the socket for the balls are, at the points where they break through into the bore, a little smaller than the balls themselves, thus the latter are kept from dropping out inside when the collet is removed. To prevent the locking ring from slipping back so far that the balls are allowed to escape from the outside, a groove is cut around the chuck and a retaining screw tapped through the ring, as shown in Fig. 2. Several different collets are used for holding the tools, the one shown being arranged for a taper shank drill; taps and other tools not made with taper shanks require, of course, a somewhat different collet. In changing the collets in the chuck it is only necessary to raise the locking ring; this releases the balls and the collet drops out. The other collet is then inserted and the ring dropping in place locks it instantly. As the ring is always loose on the socket and there are no projecting parts whatever, the operator can safely change the collets with the machine running at any speed. This chuck is made by the Seneca Falls Manufacturing Company, Seneca Falls, N. Y.

The Treatment of Machinery in Rolling Mills.

BY G. E. FLANAGAN.

The designing of rolling-mill machinery involves some principles which are not taught in school, unless we include the school of experience as one of the recognized institutions of learning. Some of the requirements cannot well be formulated, but there is one rule that is very generally followed, which is the one that says "When in doubt make it stronger." Machinery in a rolling mill is not treated like that in a well-managed machine shop. If a wheel, a collar or a coupling sticks on a shaft, they do not stop to reason with it, except with a good, heavy sledge. In fact, the sledge is about the most common argument used in a mill in dealing with refractory machinery. If a key happens to fit too tightly, it is not filed to more exact dimensions, but it is coaxed home with a few blows as forcible as the language which accompanies them. The wheel hub may split, and, if it does, they look for another from the large stock of spares usually kept on hand; but the one thing that will not be endured with any degree of patience is delay from any cause whatever. To keep up the daily tonnage, and increase it if possible, is the aim of all concerned. Whatever tends towards this end is acceptable, and nothing else is wanted or even admitted. Sentiment is ruled out, and looks count for nothing either in the machinery or its operatives. Few white collars are seen, and when coats are found to be superfluous they are dispensed with; at times the shirts have been known to follow the coats.

Even in the ordinary practice of rolling-mill operations, machinery will break in spite of any provision that can be made based upon calculation, and the only safe guide is to have experience come to the aid of mathematics, and, when parts fail, to have them made stronger next time, and this is the course that is generally followed. If cast iron is not strong enough, steel castings are used; if bronze bushed iron valves leak or burst, all bronze ones are resorted to. Cost is scarcely considered if a saving of first cost means a possible delay or a shutdown in future operations. Mill housings are being made more and more massive, until they have come to represent an important item from the mere dead weight of cast iron which they contain. They can be made much lighter and stronger of steel, but the inertia of the immense mass of cast iron is an advantage in resisting the severe shocks and vibrations to which this class of machinery is subject. The roller tables which feed the material to the mill are now supplied with solid cast-iron rollers, cast upon heavy steel shafts, where formerly a hollow shell roller was deemed sufficient. At the present time, if hollow rollers are used for heavy duty, they are cast from steel in place of iron, and, in some cases, rollers made from solid steel forgings are used. The most common diameter for table rollers is 12 inches, but 15 is not rare, and 18-inch ones are seen at times. Those larger than 12 inches are still made hollow. Five years ago the gearing in a rolling mill was mostly cast iron; to-day it is mostly steel, with a good prospect of the cast iron being eliminated altogether.

Sometimes mill machinery fails in use without there being evident any amply sufficient cause, and then the rule of making the parts stronger is applied. At other times it fails from misuse, and this is a cause against which no provision can be made. Designers often announce their intention of making machinery "fool proof," but this is an intention which it is utterly impossible to carry out. If the fool is permitted to get his hand in at the wrong time and place, a wreck is sure to result, and the character of the wreck will depend only upon the magnitude of the forces in operation at the moment.

If water is admitted to the main cylinder of a hydraulic press or shear while a stop valve on the line leading from the pull-back cylinders is closed, something must give way, and this is an accident which occurs not infrequently. Water under pressure is not expansive, as is steam or compressed air, except in a degree so slight that it may be neglected. It does not possess a store of kinetic energy as does a rapidly revolving flywheel, and so the crash, when it does come, is not so destructive to life and property. The break is repaired or new machinery installed, and very little is said about it. It is a subject for the imaginative to consider what would happen should a vessel containing steam at 5,000 pounds pressure let go; but, with water, a cylinder may burst under this pressure and do no harm to anything but itself. In testing by hydraulic pressure, it is always necessary to see that no air has been entrapped in the system, otherwise an extremely dangerous disruption may occur.

A powerful shear may be built for cutting hot metal, and it may do its work perfectly as long as it is operated only under the conditions for which it was designed; but let a small sliver of cold steel get between the knives as they come together and they are wedged apart with a force which is practically irresistible, and the tool is at once laid up for repairs. A cold piece of steel finds its way to the mill with a similar result; this time it is a new roll, or perhaps a new housing that is called for; or, if fortune favors, perhaps only a spindle breaks, and, as spares

are always kept on hand, the damage in this case is soon repaired. But, aside from the accidents due to foolishness or carelessness, there are always some that appear to be unavoidable while human nature is as imperfect as it is. They can neither be foretold nor guarded against, and a proportion of these will occur in rolling mills as well as elsewhere, with the addition also of those which are due to the hurry and push with which the work is carried on, and we can only continue to make such provision against them as intelligence dictates or experience has proved advisable.

Some years ago I was in a large mill forming part of a very extensive plant which was being again put in operation after a long period of idleness. In a case like this, things do not run as smoothly as they should; the machinery often is not in its best condition, and some of the men are apt to be new to their work. They were rolling shape material with grooved rolls, and one of the common difficulties encountered was the accidental making of what is called "a cobble"—that is, the piece sticks in the rolls or wraps itself around the groove of one of them, forming a collar and chills there, becoming very difficult of removal if allowed to become in any degree cold. In order to remove the piece while still warm, if possible, the services of what was known as the "floating gang" were called into requisition. This gang was composed of riggers and laborers, who were generally supplied with tackle, axes, hammers, sledges, etc., and who, as the name implies, were worked at whatever part of the plant happened to need them most. Wherever these men might happen to be, it was their duty to respond instantly to a signal from the steam whistle at the mill, the same as to a fire call, with whatever implements they might chance to be using or which they could secure without delay. One day a large party of ladies and gentlemen from an institution in the South paid a visit to the mill. They made a picture for an artist, the ladies in white lawn and the men mostly in light summer hats and clothing to correspond, contrasting sharply with the blackness and gloom of the surroundings. Just as they ranged themselves near the mill, trouble occurred; a "cobble" formed in the rolls, the signal was given and members of the "floating gang" were seen coming at full speed from various points and then, for a few minutes the air was full of cries, the sound of hard blows and also hard language, but soon the cobble was removed and everything was serene again, except the temper of the manager, who experienced a keen regret that the trouble should arise just as the small army of visitors made their appearance. He derived some comfort, however, from the assurance which was freely offered him, that not one among the number would know that what they had just witnessed was anything but the regular course of proceeding, and they would go away satisfied that work in a rolling mill was something very spirited, and was really quite interesting.

The Premium Plan in a University Drawing Course.

Professor Barr, of Cornell University, has sent us the following particulars of an adaptation of the premium plan to the work of instruction in drawing. In an accompanying letter he remarks that it differs in principle from the shop use of the system "in making the inspection element of greater weight than the time element; that is, in basing the premium on grade of work primarily, and on rapidity of execution secondarily. The marks (grades) which we use are not intended to represent perfection or approach to perfection on an absolute scale. We shall interpret them about as follows: Work which merely 'passes' will be graded 60 to 70 and can earn no time premium; fairly good work will be graded 70 to 80; excellent work, 80 to 90; and very high quality of work, 90 to 100. We might as well use letters A, B, C and D; but have taken the numerical scale as conforming with the existing usage of the institution."

The full time due in the drafting room for the present term is: Eighty-one hours for course M. D. 21 (steam engine designing), 120 hours for course M. D. 23 (general machinery and millwork).

Each student, when he considers a drawing complete, is to submit it to Mr. Moss for M. D. 21 or to Professor Coolidge for M. D. 23 for provisional acceptance. If a casual scrutiny indicates that the drawing will "pass" the instructor will affix his initials and the student may proceed with the next drawing. If the drawing is not adjudged to be up to the minimum standard, additional work is to be done upon it until it passes the preliminary inspection.

It is intended to so apportion the work that the average student will need eighty-one hours to complete the term's work in course 21, and 120 hours in course 23. A student who does not satisfactorily complete this average amount of work in the scheduled time will secure a passing mark only upon making up the deficiency under such conditions as it may be deemed necessary to impose.

It is possible for a student to complete the requirements of either of these courses in less than the time specified above by earning a *time premium*, which will be awarded on the following terms:

1. To be entitled to a time premium the student must earn a grade of 70 per cent. or over, and he must complete the required amount of work within the regular time schedule for the course; that is, during regular drawing periods and before the close of the work of the term.

2. The premium is to be determined by the character of the work and the time spent during regular drawing hours in its execution. The grade of the drawing will be based upon completeness, accuracy and execution. Any student who completes the minimum requirement as to quantity of work in less than the scheduled period of time is, normally, assigned additional work to occupy the time due. If, however, his grade on the required work is 70 per cent. or over, he will be credited with a time premium, and the time for which he is held is to be reduced by the amount of such premium.

3. The premiums are to be awarded according to tables which are based upon the following principles: (a) No premium is earned on work below the grade of 70; (b) the premium for work of grade 90 or over is the full amount of time due after completion of the minimum amount of work; (c) the premium is so adjusted that it increases with the quality of the work and with the rapidity of execution.

The intention of these provisions is to

Grade.	Time Spent on Minimum Required Work in Regular Drawing Periods.									
	54	57	60	63	66	69	72	75	78	81
70–80	9	8	7	6	5	4	3	2	1	0
80–90	18	16	14	12	10	8	6	4	2	0
90–100	27	24	21	18	15	12	9	6	3	0

Course M D 21.

Grade.	Time Spent on Minimum Required Work in Drawing Periods.													
	81	84	87	90	93	96	99	102	105	108	111	114	117	120
70–80	13	12	11	10	9	8	7	6	5	4	3	2	1	0
80–90	26	24	22	20	18	16	14	12	10	8	6	4	2	0
90–100	39	36	33	30	27	24	21	18	15	12	9	6	3	0

Course M D 23.

TIME PREMIUMS IN A UNIVERSITY DRAWING COURSE.

stimulate a high grade of work first, and rapidity of execution next; to discourage haste at the expense of quality on the one hand, or spending of unnecessary time in "fussing" over the work on the other.

A student may work on his drawing outside of regular periods, if so disposed. So far as such "overtime work" improves the quality of his drawing it will help to earn a time premium, but the time so spent is not to be reckoned in awarding a premium, nor is it to be credited directly to his time account. A student may work in any regular drawing period, subject to the following restrictions (whether scheduled for that particular period or not), and credit will be given for such time as if it were according to his schedule. The right is reserved to restrict this privilege if it results in overcrowding of the room or if it threatens to impair the efficiency of the work in other ways.

This scheme is adopted as an experiment for the present term only. If continued, the scale of premiums or other features may be modified.

The first table is based on the formula,

$$P = (81 - T)\left(\frac{G - 65}{30}\right)$$

and the second on

$$P = (120 - T)\left(\frac{G - 65}{30}\right)$$

in which

P = premium time,
T = time consumed,
G = grade.

Technical Publications.

"Text Book of Mechanical Drawing." By J. S. Rooke. 88 7x10-inch pages, with 32 plates of illustrations. Published by the author, Spring Garden Institute, Philadelphia, Pa. Price, $1.50.

This is a beginner's book, its scope covering geometrical problems, projection, intersection and gearing. To the latter subject a chapter on trigonometrical elements is prefixed, which goes far enough into that subject to enable the student to understand spiral gearing, with which the book concludes. The instructions and explanations are simple and to the point. An excellent feature is the placing of the illustrations and the descriptive matter relating to them on opposite facing pages.

What a Machine Is.

Defined as near as may be in a few words every machine, whether automobile or otherwise, consists of a number of material bodies, resistances, joined together reciprocally, upon which natural forces act to produce a desired effect, and the effect may be either a state of rest or one of motion.—*Automobile Magazine.*

Beloved, if you have a good man for a competitor, stop reading right here and throw up your hat. Go over and shake hands with him and seal anew your joy over your good fortune. And after this, if you are not already doing so now, so treat him that he will know you appreciate a good thing when you see it.—*Met. L. Saley, in American Lumberman.*

A correction of a certain matter which had been generally misstated in the daily press was recently very neatly made by a metropolitan paper at the request of a man of national reputation. At the end of it the editor had this to say: "Our correspondent knows, among many other things, exactly how to persuade a newspaper to straighten out a little misunderstanding like this one. He assumes the desire on the paper's part to be just to everybody, and that accurate information with which to replace inaccurate will be gladly received and used. His method is equally shrewd and admirable." Such correspondents are a rare delight to the technical editor.

The twenty-fifth anniversary of the Engineers' Club, of Philadelphia, will be celebrated by a banquet at the Union League of that city on the evening of December 6.

Obituary.

William E. Davis died at Jersey City, N. J., November 13, eighty-two years old. He was a native of Ireland, and had lived in Jersey City since 1828. He was for many years a foreman in the Rogers Locomotive Works. Since 1873 he had been manufacturing electrical machinery, and had developed a number of inventions in that line.

Charles Davis, a retired steam engineer and machinist, died at Troy, N. Y., November 7, eighty-one years old. Mr. Davis was born in the west of England, and at the age of fifteen saw the launching of the "Great Western," the first steamship to carry passengers across the Atlantic. He later served as an engineer upon her and also upon the "Great Britain" of the same line. He first worked in this country at Matteawan, N. Y., on the construction of the "Atlantic" and the "Pacific," the first two locomotives of the Hudson River Railroad. In 1853 he became foreman of the machine shops of the Burden Iron Works at Troy, and later he was superintendent of the horseshoe department, retiring in 1888.

Charles Moehlmann, foreman of iron foundry of the General Electric Company, Schenectady, N. Y., died suddenly at his home in Schenectady, on Friday, October 31. Mr. Moehlman was born in Nittlestadt, Westphalia, in 1856, and after attending common schools until he was fourteen years of age, he started in his father's foundry to learn the molder's trade, after which he had the usual term of three years' service in the German Army. In 1882 he emigrated to America and worked for four years in an iron foundry in Amsterdam, N. Y., and also worked in several other foundries until January, 1888, when he secured employment as molder with the Edison General Electric Company and continued in their employ until his death. He was a foundryman of very unusual ability, as the writer knows from personal observation of his work. Few, if any, foundries employ more original methods than that of the General Electric Company. In fertility of invention of such methods, no less than as an executive head, Mr. Moehlman was a leader. He was repeatedly solicited to contribute articles for our columns, but, with the modesty that so often accompanies merit, he felt himself incapable of such work. He was appointed foreman of the iron foundry in 1895. A widow and six children survive him.

Commercial Review.

NEW YORK, November 17, 1902.

During the past year, and particularly during the past few months, there has been an unmistakable tendency toward large industrial establishments moving from crowded cities to small towns. This practice has obtained quite prominently in the Eastern States, particularly in New England. In Greater New York recently, the tendency has been most noticeable, and frequently the removal of some large plant is chronicled.

New Jersey easily leads in attractive locations for large manufacturing establishments. Statistics show that it has made notable strides in this direction during the past year. At Harrison, which is a suburb of Newark, Henry R. Worthington, manufacturer of pumps, is erecting a large machine shop which, when completed, will have formed an outlay of $1,000,000, including equipment. The removal of this concern from Brooklyn will deprive that locality of one of the oldest industrial establishments.

Announcement has already been made in these columns of the removal of the plant of the Jordan L. Mott Iron Works, of this city, to Trenton, just as soon as the necessary construction will permit, and the number of smaller concerns which will operate their plants in the near future in different parts of New Jersey is quite large.

Some time ago there was a company organized to develop the Hackensack Meadows as a site for manufacturing establishments, but it has not made any notable headway, particularly if the price of its stock is taken as a criterion. We understand that the marshy aspect of the soil has had a great deal to do with manufacturers looking askance at it as a location for their plants.

The question of taxation figures quite largely in the desire of manufacturers to remove their plants from the large cities. In Greater New York evidence of this fact is easily obtainable. It is strange, too, that if any large industrial establishment in Greater New York were to announce

that it was compelled to move elsewhere, in consequence of excessive taxation, its grievance would receive no other consideration beyond a notice in the newspapers. As for the city authorities interesting themselves in the matter, that would be out of the question.

On the other hand, the administrative authorities of small communities, and particularly Boards of Trades representing them, display great and commendable zeal in inducing manufacturers to locate in their midst, and frequently we not only hear of them offering free sites, either through legislative grant or by public subscription, but also exempting them from taxation.

Mr. Bryan, during his last Presidential campaign, repeatedly declared the Administration's policy in the Philippines to be "philanthropy and 5 per cent."—and the policy we have described can be interpreted in the same way, for the transition of many an insignificant town into a progressive city, at least on a small scale, may be traced to its adoption. Railroad facilities form another important element, and so far as this vicinity is concerned, New Jersey's prestige in this connection is of the highest.

Coincident with the location of manufactories in small towns, a little labor problem has developed. Experience has shown that workingmen are averse to settling in them, and when by choice or necessity they do, they seize the first opportunity of employment in or near large cities that presents itself. We personally know of the representative of a large machine shop in Vermont coming to this city a short time ago for the sole purpose of engaging the services of at least fifty machinists, and at wages that were on a parity with any obtainable here, and, after approaching machinists' unions and advertising in local newspapers, was forced to return with only eleven hands. When interrogated concerning his experience, this man declared that the process of transforming a city man into a "Rube" was apparently attended with some difficulties, but that the reverse was as natural as breathing.

Measured, however, by every standard that can possibly make a man a useful member of society, this condition of affairs is to be regretted. Rural communities—we simply use the term to distinguish them from large centers of population—should not appeal alone to the poet's fancy or painter's art, but to those who believe in the doctrine of plain living and high thinking, and who are anxious that the reign of both should not perish from the earth.

In pig-iron "orders for 1903" may be said to constitute the main feature of the raw material market, but nowadays the same term obtains quite largely in the purchase of nearly every kind of machinery. So far as machine tools are concerned, our advices are that it is doubtful if any order given for them now could be executed before the early part of next year. This is particularly true of large machine tools, deliveries of which, if ordered now, could not be promised before well into the first quarter of the new year.

Concerning deliveries in general, we are advised that they are better now than they have been recently, although by no means as satisfactory as desired. For this better foundry conditions is assigned as a reason, though foundrymen say the inability to procure coke still constitutes a serious impediment to filling orders for castings as quickly as they would like.

Not long ago, in these columns, we stated that evidences were multiplying that whatever reason there may have been in the past for regarding Wall Street as a barometer of trade, its distinction in this respect was fast disappearing. Whatever doubt may have been entertained in the matter has been dispelled recently, and particularly on last Thursday, when the stock market underwent liquidation on a large scale, some stocks declining eight points.

The extreme declines on the day in question, as compared with the highest prices which prevailed on the previous day, were replete with object lessons, and demonstrated that between Wall Street's regard for a stock and the condition of the industry it represented, a meeting on an equal footing was impossible.

For example, Pennsylvania Railroad stock declined 3½ points, Reading Railroad stock 4 points, Baltimore & Ohio Railroad stock 5½ points, United States Steel Corporation preferred stock 1⅞ points, and General Electric stock 3¾ points.

That there was no valid reason for these declines is shown in the fact that the Pennsylvania and Reading roads are doing such an immense business that only a few days ago they voluntarily raised the wages of their employees 10 per cent. Dispatches from Baltimore are to the effect that because of good business also the Baltimore & Ohio Railroad contemplates increasing the wages of its employees 10 per cent. The recent report of the United States Steel Corporation shows its operations to be along the most successful lines in its history, recent reductions in the price of some of the products being due to increased producing, rather than decreased consuming, capacity. As for the General Electric Company, its business was never better, a recent statement showing that its gross earnings have now gone beyond $800,000 weekly.

Commercial agencies report that business conditions never had a more salutary environment than they have now. In the iron and steel industry at present, business is all that could be desired, and the outlook, particularly in the machinery line, is of the best. Yet, in the face of these facts, Wall Street is surcharged with a panicky atmosphere. Well indeed does a conservative journal in this city ask: "Is it not plain to everyone that the Stock Exchange is capable of detaching itself from prevailing conditions of trade and industry to an extent which it makes it no longer a useful or a safe indication of what is really going on in the United States of America?"

The crane and hoist demand is in excellent condition, as reported by Pawling & Harnischfeger, Milwaukee, Wis. They advise of their recent booking of orders as follows: Baldwin Locomotive Works, Philadelphia, two 10-ton cranes; Manitowoc Steam Boiler Works, Manitowoc, Wis., one 35-ton crane; Consolidated Railways, Light & Power Company, Wilmington, N. C., one 10-ton crane; Pennsylvania lines west of Pittsburgh, Ft. Wayne, Ind., one 1½-ton hoist; the Lorain Steel Company, Johnstown, Pa., one 7-ton crane; American Sheet Steel Company, Cambridge, Ohio, one 5-ton crane; Berlin Machine Works, Beloit, Wis., one 1½-ton hoist; The Lorain Foundry Company, Lorain, Ohio, one 5-ton crane; Allis-Chalmers Company, Chicago (for export), one 30-ton crane with 4-ton auxiliary hoist; Colean Implement Company, Peoria, Ill., one 10-ton crane; Allis-Chalmers Company, Fraser & Chalmers Works, Chicago, one 30-ton crane with 8-ton auxiliary hoist; Gruson Iron Works, Eddystone, Pa., one 20-ton crane; Isaac G. Johnson & Co., Spuyten-Duyvil, N. Y., one 3-ton hoist; Allis-Chalmers Company, Chicago, one 5-ton crane; American Bridge Company, Milwaukee plant, Milwaukee, one 5-ton special riveter crane.

In order to make additional room at their factory for manufacturing purposes, the Cushman Chuck Company, of Hartford, Conn., have leased the large store with basement at 189 Allyn street, near Union Station, where they have removed their general office, together with their stock of finished chucks. This not only gives them improved facilities for shipping and handling generally their rapidly growing business, but it makes immediately available a considerable space in their factory, which, together with contemplated additions, will be utilized for new machinery.

The Frank Mossberg Company, of Attleboro, Mass., is the name of a new corporation recently organized in Rhode Island, with a full paid-up capital of $110,000, to succeed to the business of the Frank Mossberg Company, which has heretofore been a copartnership. The main business of the company will be the manufacture of sheet metal punchings and stampings, and the production of finished articles therefrom, in addition to which it will operate a thoroughly equipped machine shop for the manufacture on order and contract of punching dies, special tools and anything and everything in the line of light machinery; making a specialty of the perfecting of new inventions, and the mechanical development of experimental devices of all kinds.

The floor area of the Attleboro factory

is half an acre, and the new capital obtained will be invested in additional machinery. A specialty will be made of the development of new machines. Inventors and capitalists can have their ideas worked out in the shops under their own supervision. During the past few months automobiles, spinning machinery, looms, typewriters, etc., were built to order for the parties preparing to exploit their ideas. Mr. Mossberg has no connection with the Mossberg & Granville Company, of Providence, or the Mossberg Wrench Company, of Pawtucket, both of which are manufacturing roller bearings, wrenches, etc., under his older patents.

Messrs. Charles H. Besly & Co., 10-12 North Canal street, Chicago, Ill., report their general business very good. They have a large and varied assortment of seamless brass and copper tubing in stock, numbering 300 sizes, varying from 1-64 inch outside diameter to 8½ inches outside diameter. Brass rod, sheet, wire and brazed tubing; braziers' sheet copper, soft and cold rolled copper Anodes; brush copper for electrical purposes; German silver sheet, rod and wire are also carried in stock. Their new store building on Clinton street is progressing rapidly and will give them over double the space of their present five-story building, 10-12 North Canal street. Their 300-page catalog will be mailed free on application.

The Northern Engineering Works, crane builders, Detroit, Mich., have begun the construction of a 65-foot addition to their erecting shop, extending it to a length of 200 feet by 70 feet wide. The building will be of steel and brick with a slate roof, and will have a 20-ton electric crane.

Work is being pushed on the new office and factory structure which will be erected by the Universal Accountant Machine Company, at Laclede and Vandewater avenues, St. Louis, Mo. The site the building will occupy is 153x213 feet. The plant will be very complete in every detail and embody every mechanical and scientific appliance requisite to the manufacture of such delicate, yet highly practical, machines, as the adding machine has grown to be in the commercial world.

CHICAGO MACHINERY MARKET.

Transactions in electrical equipment for shops and factories have been more numerous during the past month than for the preceding month. Large factory installations are no longer rare, and, moreover, from those shops that are already equipped there is coming a quite considerable volume of new business. The railroad companies in the West are among the leaders in this electrical equipment movement. Railroad shops are developing with greater strides than for some time past. Work is crowding into them at an unprecedented rate and the companies are not only engaging more extensively than ever before in repair work, but are preparing for new construction. Thus it is currently reported that the Burlington road will soon begin the construction of a thousand freight cars at their Aurora (Ill.) shops. The Chicago Great Western road, which has its shops at Oelwein, Ia., equipped with three 100-kilowatt generators, has just ordered another—a 400-kilowatt generator—from the Crocker-Wheeler Company, which sold the power previously installed. The Milwaukee shops of the Chicago, Milwaukee & St. Paul road are to be equipped electrically throughout and a large contract for the power will probably be let soon. The Big Four system has specifications out for the electrical power for the Peoria & Western shops at Urbana, Ill.

From the manufactories the inquiry is no less active. The Lima Locomotive Works will more than double their electrical power. It will amount to 400 or 500 horse-power and will be furnished by the Sprague Electric Company. The latter company has sold a 300 horse-power generator for installation in the Ewart Building, a power building at 1115 South Jefferson street, Chicago. The Racine Wagon & Carriage Company has installed an electrical equipment of about 200 horse-power generators and motors each. The American Cutlery Company has installed in its plant at Chicago an equipment of 100 horse-power in generators and motors each. The Cleveland Furnace Company, Cleveland, Ohio has made large electrical additions to its plant. J. H. McWilliams, of Louisville, Ky., has the contract for a complete electrical equipment for the Arcade Building, Dayton, Ohio, comprising a complete heating and ventilating system and electric elevators.

The Chicago office of the Crocker-Wheeler Company had in October the best month's business in its history. Most of the business was small work. Among motors sold were 140 horse-power for the Winslow Bros. Company, 100 horse-power for the Hicks Locomotive Works and 300 horse-power for the Brunswick-Balke-Collender Company, all of Chicago.

Quotations.

NEW YORK, Monday, November 17.

New York prices for Northern and Southern irons for the first half of 1903 are as follows:

Northern:	
No. 1 X	$23 25 @ $24 75
No. 2 X	22 00 @ 22 75
No. 2 plain	21 00 @ 21 75
Southern:	
No. 1 Foundry	23 25 @ 23 50
No. 2 Foundry	22 25 @ 22 50
No. 3 Foundry	21 50 @ 22 00
No. 4 Foundry	20 50 @ 21 50

Bar Iron—Base sizes—Refined brands, mill price on dock, 1.93c. upward in carload lots. Smaller quantities from store, 2.15 @ 2.20c.

Tool Steel—Base sizes—Good standard quality, 7c.; extra grades, 10c. and upward.

Machinery Steel—Base sizes—From store, 2.10 @ 2.25c.

Cold Rolled Steel Shafting—2.90c. from store for base sizes.

Copper—Lake Superior ingot, 11⅝ @ 11¾c.; electrolytic and casting, 11⅜ @ 11½c.

Pig Tin—In 5- and 10-ton lots, f. o. b. New York, 25½ @ 25⅝c.

Pig Lead—4.10 @ 4.12½c., in 50-ton lots.

Spelter—5⅜ @ 5½c.

Antimony—Cookson's, 9 @ 9½c.; Hallett's and U. S., 7¼ @ 7½c.

Lard Oil—Prime City, 86 @ 89c., according to brand and quantity, ranging from one barrel up to large lots.

Manufacturers.

Parsons, Rich & Co. (Inc.), manufacturers of automatic feeders, Newton, Ia., will build a new factory.

Roth & Englehardt, 2 East Forty-seventh street, New York, manufacturers of piano actions, are considering the enlargement of their plant at St. Johnsville, N. Y. Their orders for electric players are exceeding their present capacity.

The Mossberg & Granville Manufacturing Company, Providence, R. I., manufacturer of metal-working machinery, roller bearings, etc., is about starting to build a plant at Pawtucket. It will include a building, 200x72 feet, two stories, with an "L" and a blacksmith shop. The plant will be run by electric power, which will be supplied by the Pawtucket Electric Company.

Negotiations have lately been under way, which may lead to the establishment of a large iron and steel works at Toronto, Ont. Alderman Richardson and Assessment Commissioner Fleming have been treating with the parties. The concern is closely associated with the Dominion Steel & Iron Company, and would expect to get its raw material in the form of steel billets from Sidney, N. S.

It is stated at Pittsburgh, Pa., that the Columbia Fireproofing Company, which has been operating a small plant in London, will enlarge its factory there. Attempts made to secure the machinery in England were unsuccessful, and C. V. Childs, the chief engineer of the company, came to this country recently to let the contracts. The improvements will cost in the neighborhood of $50,000.

Nashville, Tenn., capitalists have applied for a charter for a hardwood floor factory. The capital stock is to be $100,000 and the incorporators are John B. Ransom, Arthur B. Ransom, John W. Love, W. K. Phillips and James McReynolds. The company proposes to build a plant in West Nashville. John B. Ransom & Co. will manage and operate the new plant, but it will be distinct from from their own mills.

A company is being organized at McComb, O., to manufacture the "Little Star" grain separator, invented and patented by James W. Hall, of Dublin, Ind. The company is capitalized at $20,000, and the following are interested: James Hatfield, of Dublin, Ind.; Hickerson & Kinsey, Martin & Weinland, Stoker Bros., McGinnis & Griffith, J. C. Bright, M. C. Pendleton, R. D. Warren, Scott Warner and R. L. Poe, all of McComb.

At Sault Ste. Marie, Mich., William Chandler, of the Chandler-Dunbar Water Power Company, which controls the rights of the St. Mary's Falls, north of the ship canal, and

has power developed, is quoted as saying that plans have been perfected for the establishment of a paper mill. The American Soo Paper Company has been capitalized at $4,000,000, and the money proposed for its investment at the Soo has been provided for.

It is reported that the American Locomotive Company is behind a syndicate which has purchased land at Longue Point, near Montreal, Que., and that a plant to employ more than 1,500 men will be established there. In connection with this is a rumor that the company has purchased the Kingston Locomotive Works and will remove them to Longue Point. Quite a while ago the purchase of these works was reported, but it was then denied.

"The Manufacturing Company of Pittsburg" is said to have bought a large tract of land at Masontown, Pa. It has, it is stated, closed a deal for the erection of a foundry and works for the manufacture of gas-burning fixtures under the Edwards patents, and will bring to Masontown the Edwards Carbide Works. Among those concerned in the enterprise are A. E. Anderson, L. T. Flint, J. W. Stuart, George Krantz, T. C. Edwards and S. M. Mullen, of Pittsburg.

Three large electrical plants are about to utilize the power of the Susquehanna River. The first is Conewingo Falls, and will generate 35,000 horse-power. The company has been capitalized at $4,000,000. The object is to send power to Wilmington and Chester. A second plant will be built at Peach Bottom and McCall's Ferry. It is proposed to generate 40,000 horse-power. The company has been capitalized at $10,000,000. The current will be distributed to Baltimore and vicinity. A third plant will be erected at York Furnace by the American Pipe Company, of Philadelphia. The company will be capitalized at $5,000,000. It is proposed to generate 40,000 horse-power.

The property, in Chicago, at 12 to 22 South Clinton street, extending south from the alley between Washington and Randolph streets, has been sold in three parcels. The north 40 feet was sold to William Ganschow, manufacturer of gear cutting machinery, for $22,000. The property at 16 and 18 was sold to Henry D. Sharpe, of the Brown & Sharpe Manufacturing Company, for $16,478. The 47.92 feet at 20 and 22 were sold to John Hewett, president of the Miehle Printing Press & Manufacturing Company, for $26,400. These purchases are taken to indicate the tendency of machinery houses and kindred lines to overflow west from the congested machinery center at Canal and Washington streets.

The Lunkenheimer Company, Cincinnati, O., manufacturer of brass and iron goods and specialties for engines, boilers, etc., on Saturday, October 25th, formally opened its new works to about 3,000 visitors and friends and is now moving from its old quarters on Eighth street. The new factories are located near Brighton station, in a section of the city called Fairmount, within two miles of the center of the city. They cover about three acres. There are five structures—the brass department, iron department, brass foundry, power building and office building, all of pressed brick and steel construction. The main one is occupied by the brass department, of gallery style construction and has three stories so arranged that three more stories can be added without interfering with the business. The heating system is interesting, the hot air traveling through fourteen large, hollow columns which support the floors. The windows have a blind arrangement that is of advantage during summer weather. The foundry is equipped with modern appliances, such as the overhead track system for carrying material, smelting furnaces burning crude oil, and many pneumatic appliances. The source of power is a 300 horse-power compound engine which drives a 240-kilowatt, three-phase, 220-volt, alternating current dynamo. The power from the motors to the shafts is transmitted by the Renold silent chain gear. The illumination is furnished by lamps of the Nernst Lamp Company, Pittsburgh. The light is claimed to more closely resemble sun light than does gas, incandescent or arc light, and articles exhibited under it have their true color value. The distribution of the light is even and without shadows. The lamps are so arranged that sufficient illumination is secured without providing each operator with an individual light. The company has placed many orders for additional tools and machinery, which are being installed in its new quarters.

Miscellaneous Wants.

Advertisements will be inserted under this head at 25 cents a line, each insertion. Copy should be sent to reach us not later than Saturday morning for the ensuing week's issue. Answers addressed to our care will be forwarded.

Grant. Gears. See upper corner, page 54.

Punches & dies. Wal.M.Wks.,Waltham,Mass.

Caliper cat. free. E. G. Smith, Columbia, Pa.

Order your new or special machines from the Industrial Mach. Co., Newark, N. J.

Will buy or pay royalty for good patented machine or tool. Box 282, AMER. MACH.

Wanted—Improvements in grinding machinery. Address Box 1435, Providence, R. I.

Light and fine mach'y to order; models and elec. work specialty. E. O. Chase, Newark, N. J.

First-class designing, drafting and tracing done to order. Address "Experienced Designer," care AMERICAN MACHINIST.

The Wellman Sole Cutting Machine Co., of Medford, Mass., designs and builds light machinery. Correspondence solicited.

An experienced engineer will perfect, simplify or improve upon articles of manufacture. Address Box 236, AMERICAN MACHINIST.

Wanted—Machinists and draftsmen to send postal for free set tables of lathe gearing and valuable formulas. Box 239, AMER. MACH.

Wanted—An interest in a hardware, mill supply, machinery or belting business in New York city. Address "Cash," care AM. MACH.

Oil Engines.—Book by Goldingham; valuable for designers, builders, users of oil or gas engines; postpaid for $2. Spon & Chamberlain, 123 Liberty, New York.

We manufacture on contract patented hardware specialties, tools, dies, metal stampings, special machinery, etc. Edmonds-Metzel Mfg. Co., 778 to 784 W. Lake st., Chicago, Ill.

Grinding beats filing; try us, on either hardened or soft work; capacity 7 in. diameter, 48 in. long and under. The Garvin Machine Co., Spring and Varick sts., New York.

Designs of gas engines for natural, producer and blast furnace gas, of gas power plants and for converting steam engines into gas engines, made to order. Box 237, AM. M.

Wanted—Light machine work and special machinery to build to order, special tools, die and punches; a well-equipped water-power plant and first-class workmen. The Bantam Mfg. Co., Bantam, Conn.

For Sale—Right of U. S. patent No. 610,745; up-to-date spring power hammer; not for royalty; complete file working drawings for several sizes, ready for put in work to-morrow. Box 225, AMERICAN MACHINIST.

Wanted—Machinist, with from $1,000 to $2,000, to take an interest in and the superintendency of a concern manufacturing laundry machinery in Chicago. Address C. T. Cummins, 210 Larrabee st., Chicago, Ill.

For Sale—A well equipped foundry and machine works, located in a healthy town of about 15,000 population in Alabama; reason for selling, poor health of managing partner. If interested address "Alabama," care AM. M.

Wanted—A large contract to build medium or light automatic machinery; we have the plant, the experience, the capital; cam cutting a specialty; we make the best adjustable reamers. Ott. Mergenthaler Company, Baltimore, Md.

Purchaser for small manufacturing plant in Madison, Wis.; lot, 100x180 feet; machine shop, 32x68, two story, with line shaft and gasoline power; foundry, 40x54, new modern equipment; good location; for sale cheap. Hart-Parr Co., Charles City, Iowa.

A money-making metal working and stamping plant for sale; orders easy to get and at good prices; good specialties and ready customers for them; capable of great expansion, and profits will pay at a rapid rate for all additions and improvements; special reasons for selling; price $25,000. Address Box 232, A. M.

Wants.

Situation and Help Advertisements only inserted under this head. Rate 25 cents a line for each insertion. About six words make a line. No advertisements under two lines accepted, and no advertisements abbreviated. The cash and copy should be sent to reach us not later than Saturday morning for the ensuing week's issue. Answers addressed to our care will be forwarded. Applicants may specify names to which their replies are not to be forwarded; but replies will not be returned. If not forwarded they will be destroyed without notice. Original letters of recommendation or other papers of value should not be enclosed to unknown correspondents.

Situations Wanted.

Machine designer, etc., wants position. Address Box 63, AMERICAN MACHINIST.

Mechanical draftsman wishes position. Address Box 222, AMERICAN MACHINIST.

Draftsman, mechanical, open for engagement. Box 229, AMERICAN MACHINIST.

As foreman, by A1, progressive patternmaker. K. G., care AMERICAN MACHINIST.

Experienced mechanical draftsman desires position. Box 192, AMERICAN MACHINIST.

Toolmaker, young man, wishes steady position on light work. Box 226, AMER. MACH.

Experienced mechanical draftsman wishes position near New York. Box 210, AM. MACH.

Foreman patternmaker wishes a change after January 1. Box 219, AMER. MACHINIST.

Draftsman, with experience in steam engine practice, wishes position in similar work. Box 227, AMERICAN MACHINIST.

Mechanical engineer, general work, desires position as chief draftsman or superintendent. Box 231, AMERICAN MACHINIST.

Draftsman, familiar with printing press design, gained in American shops, wants position. Box 224, AMERICAN MACHINIST.

Position of responsibility, by competent machine shop or toolroom foreman; A1 references. Box 205, AMERICAN MACHINIST.

A toolmaker and modelmaker on fine work wants position; can take charge of manufacturing. Box 214, AMERICAN MACHINIST.

Manufacturing engineer; labor-saving methods; special tools, jigs, etc.; correspondence solicited. Eugene Wilson, care AM. MACH.

Young Swedish draftsman, 6 years' experience in shop and drawing room, desires employment. Box 235, AMERICAN MACHINIST.

Mechanical draftsman, technical graduate, wants position; 5 years' experience on general machinery. Box 234, AMERICAN MACHINIST.

Young man (22), good education, would like situation in machine shop; electrical preferred; best reference. Box 230, AM. MACH.

First-class draftsman, graduate, desires position; designing of hoisting machinery, dredges and steam shovels a specialty. Box 221, AMERICAN MACHINIST.

General foreman, responsible, age 34, experienced in high-class automatic machinery, wishes to make change about December 1. Box 238, AMERICAN MACHINIST.

Mechanical engineer is open for engagement; technical education; large experience as foreman and superintendent, manufacturing small and medium interchangeable machinery. Box 233, AMERICAN MACHINIST.

Position wanted as general foreman, by man 31 years old; have had 9 years' experience as foreman of machine shop, bicycle and automobile work; can furnish good references. Box 223, AMERICAN MACHINIST.

Expert on automatic machinery, light and heavy; first-class designer; inventive ability; 10 years' best experience; graduate; fitted for head draftsman, superintendent or to develop inventions; terms moderate. Box 187, A. M.

A up-to-date machine shop foreman wishes to make a change; 10 years foreman with present employer; first class at designing jigs and fixtures; heavy machine tool work preferred; first-class references. Box 220, A. M.

Mechanical engineer, 29, technical graduate, 6 years' experience, desires change position; prefers to locate in the commercial end of some business where his technical training and experience would be of value. Address Box 228, AMERICAN MACHINIST.

Position wanted as general foreman or superintendent; now employed, but desiring change; modern, up-to-date ideas and a cost-

cutter and organizer; medium or heavy machinery or machine tools; Middle States preferred. Address Box 195, AMER. MACHINIST.

Help Wanted.

Machinists—Your working drawings made by G. M. Mayer, M. E., Monadnock, Chicago.

Machinists, to introduce my double jaw caliper system. E. G. Smith, Columbia, Pa.

Shop agents wanted to handle my test indicator. See my illustrated ad., page 66. H. A. Lowe, Waltham, Mass.

Wanted—Two good wood patternmakers, experienced on pumps and hydraulic work. The Goulds Mfg. Co., Seneca Falls, N. Y.

Wanted—Assistant inspector in large manufacturing establishment, doing high-grade mechanical work. Address Box 217, AM. M.

Wanted—First-class machinists, in city near Philadelphia; steady work and good pay. The Reeves Engine Co., Trenton, N. J.

Wanted—First-class, non-union, all-round machinist; good shop and tools; work every day in the year. Box 190, AMER. MACHINIST.

Machinists, send 5 cents for blueprint table of U. S. standard steam, gas and water pipe, giving tapping sizes. Address E. E. Meyer, Allegheny, Pa.

Wanted—At once, first-class machinists on jig and fixture work; none others need apply. Call on or address The Taft-Peirce Mfg. Co., Woonsocket, R. I.

Wanted—Positions for experienced men, and men for such positions. Address James Brady (late Brady Mfg. Co.), Room J, 20th Floor, 220 Broadway, New York.

Wanted—Lathe and planer hands for night work on heavy machine tool work; good wages to good men. Apply to The Pond Machine Tool Company, Plainfield, N. J.

Wanted—An energetic, practical man as general foreman in large textile machine shop; state age, experience, qualifications and salary. P. O. Box 2815, Boston, Mass.

Good mechanical draftsman with designing ability wanted in large manufacturing company; state age, education, experience and salary expected. Address Box 206, AM. MACH.

Wanted—A young man to take care of order book in a jobbing foundry; must be familiar with patterns and core boxes; steady work at good wages. Box 191, AMER. MACHINIST.

Wanted—First-class iron-working machinery salesman; but little traveling required; all correspondence treated confidentially. Address, with references, Nortnern Machinery Co., Minneapolis, Minn.

Wanted—Man experienced in the operation of universal grinding machines, and with good general mechanical ideas; experimental work; state age, experience, references and salary expected. Box 212, AMERICAN MACHINIST.

We are constantly increasing the scope of our work, and invite applications for positions from first-class patternmakers, molders and machinists; we always have vacancies. Address The Westinghouse Machine Company, East Pittsburg, Pa.

Toolmaker, to teach an evening class in toolmaking, three nights per week, from 7.30 to 9.30, in New York city; only those having wide experience and first-class references need apply. Address, giving full particulars, "Toolmaker," care AMERICAN MACHINIST.

Wanted—Assistant purchasing agent, by large manufacturing concern in Ohio; one familiar with all kinds of raw material; good salary, with prospects of advancement, to the right man; no application will be considered unless previous experience and references are given. Address H. F. D., care AMER. MACH.

A manufacturing company 50 miles from Chicago wants three good machinists for steady, light work at construction and repairs of weaving machinery; quality of work is good and accuracy is required. Address, stating full particulars of experience, etc., Western Cane Seating Company, Michigan City, Ind.

Manager wanted for an electrical manufacturing business; must be thoroughly experienced in economic machine shop management, preferably electrical, and familiar with accounts and estimates; state compensation required and give references; all communications strictly confidential. Address Box 218, AMERICAN MACHINIST.

Wanted—Two or three first-class floor hands on fitting and erecting heavy machinery, one turret lathe operator and one first-class planer hand; good wages and steady employment; none but first-class workmen need apply. Address Farrel Foundry & Machine Co., Ansonia, Conn., giving age, experience and wages required.

Wanted—Machinist, or other good party, in every shop, to take orders for "Loetzer's Hand-Book of Practical Rules and Tables for Machinists and Engineers," also for "Loetzer's Treatise on the Slide-Valve and Locomotive Valve-Setting"; 65 cents and $1 per copy; these books sell themselves; thousands sold annually; liberal discounts to agents. Send for printed matter and terms. C. E. Loetzer, 10 Cherry st., Towanda, Pa.

Wanted—A young man to act as correspondence clerk in a manufacturing establishment; one who is skillful in the use of the typewriter, whose tastes are mechanical and along literary lines, with ability to do cataloging, edit advertisements, circulars and other printed matter that may be necessary in connection with a line of special machinery; give age, experience, salary expected, references, etc. Address Box 204, AMER. MACHINIST.

Wanted.—Machinists, toolmakers, draftsmen, do you want to increase your salary? They all say that Saunders' enlarged edition "Hand Book Practical Mechanics" exactly fills the bill for valuable shop kinks, rules, etc., figured out by simple arithmetic and drawings; also most complete reference tables in existence, many taken from note books of best mechanics in the country. Pocket size. Price, post paid, only $1, cloth; $1.25 leather. Agents wanted. Book sells itself. Big money. C. H. Saunders, 216 Purchase st., Boston, Mass.

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Abrasive Material Co., Phila., Pa.
Carborundum Co., Niagara Falls, N. Y.
Northampton Emery Wheel Co., Leeds, Mass.
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Arbor Presses
Barnes Co., W. F. & John, Rockford, Ill.
Bartlett, E. E., Boston, Mass.

Ball Bearings
See Roller Bearings.

Balls, Steel
Federal Mfg. Co., Cleveland, O.

Band Saws
American Machinery Co., Grand Rapids, Mich.

Barrels, Steel
Cleveland Wire Spring Co., Cleveland, O.

Bars, Boring
Cleveland Twist Drill Co., Cleveland, O.
Underwood & Co., H. B., Philadelphia, Pa.

Bearing Metal
Phosphor Bronze Smelting Co., Philadelphia, Pa.

Belt Dressing
Dixon Crucible Co., Jos., Jersey City, N. J.
Houghton & Co., E. F., Philadelphia, Pa.

Belt Lacing Machines
Diamond Drill & Mach. Co., Birdsboro, Pa.

Belt Filler
Schieren & Co., Chas. A., New York.

Belting, Leather
Schieren & Co., Chas. A., New York.
Shultz Belting Co., St. Louis, Mo.

Bending Machines, Power
Bethlehem Foundry & Mach .Co., So. Bethlehem, Pa.
National Mchry. Co., Tiffin, O.
Reade Mchry. Co., Cleveland, O.

Bending Machines, Hydraulic
Bement, Miles & Co., New York.
Watson-Stillman Co., New York.

Blocks and Tackles
See Hoists, Hand.

Blowers
Am. Gas Furnace Co., N. Y. City.
Buffalo Forge Co., Buffalo, N. Y.
Champion Blower & Forge Co., Lancaster, Pa.

Boilers
Struthers, Wells & Co., Warren, Pa.

Bolt and Nut Machinery
Acme Mchry. Co., Cleveland, O.
Detrick & Harvey Mach. Co., Baltimore, Md.
National Mchry. Co., Tiffin, O.
Pratt & Whitney Co., Hartford, Conn.
Ray Automatic Mach. Co., Cleveland, O.
Reliance Mach. & Tool Co., Cleveland, O.
Webster & Perks Tool Co., Springfield, O.
Wells Bros. Co., Greenfield, Mass.

Books, Mechanical
Audel & Co., Theo., New York.
Baird & Co., Henry Carey, Philadelphia, Pa.
Derry-Collard Co., New York.
Henley & Co., N. W., New York.
Van Nostrand Co., D., New York.
Wiley & Sons, John, New York.

Boring and Drilling Machines, Horizontal
Barnes Co., B. F., Rockford, Ill.
Barnes Co., W. F. & John, Rockford, Ill.
Beaman & Smith Co., Provl., R. I.
Bement, Miles & Co., N. Y. City.
Betts Mach. Co., Wilmington, Del.
Binsse Mach. Co., Newark, N. J.
Dallett & Co., Thos. H., Phila., Pa.
Detrick & Harvey Mach. Co., Baltimore, Md.
Fosdick Mach. Tool Co., Cincinnati, O.
Franklin Mach. Wks., Phila., Pa.
McCabe, J. J., New York.
Newton Mach. Tool Wks., Philadelphia, Pa.
Niles Tool Works Co., New York.
Pond Mach. Tool Co., New York.
Pratt & Whitney Co., Hartford, Conn.
Prentiss Tool & Supply Co., New York.
Warner & Swasey Co., Cleveland, Ohio.

Boring and Turning Mills
American Tool Wks. Co., Cin., O.
Baush Mach. Tool Co., Springfield, Mass.
Bement, Miles & Co., New York.
Betts Mach. Co., Wilmington, Del.
Bullard Mach. Tool Co., Bridgeport, Conn.
Hill, Clarke & Co., Boston, Mass.
McCabe, J. J., New York.
Niles Tool Works Co., New York.
Pond Mach. Tool Co., New York.
Prentiss Tool & Supply Co., New York.
Warner & Swasey Co., Cleveland, Ohio.

Bucket Elevator
Clark Co., W. J., Salem, O.

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National Mchry. Co., Tiffin, O.

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Car Link Machines
National Machy. Co., Tiffin, O.

Castings, Brass and Bronze
Christensen Engineering Co., Milwaukee, Wis.
Nolte Brass Co., Springfield, O.
Phosphor Bronze Smelting Co., Philadelphia, Pa.

Castings, Die Molded
Franklin Mfg. Co., Syracuse, N. Y.

Castings, Motor
Graves Motor & Mfg. Co., St. Paul, Minn.

Castings, Steel
Christensen Engineering Co., Milwaukee, Wis.
Uniform Steel Co., Newark, N. J.

Centers, Planer
Fay & Scott, Dexter, Me.
New Haven Mfg. Co., New Haven, Conn.
Pratt & Whitney Co., Hartford, Conn.
Reed Co., F. E., Worcester, Mass.

Centering Machines
Bement, Miles & Co., New York.
Kempsmith Mfg. Co., Milwaukee, Wis.
Niles Tool Works Co., New York.
Phoenix Mfg. Co., Hartford, Ct.
Pond Mach. Tool Co., New York.
Whiton Machine Co., D. E., New London, Conn.

Chains, Driving
Boston Gear Works, Boston, Mass.
Federal Mfg. Co., Cleveland, O.
Bridgeport Chain Co., Bridgeport, Conn.
Jeffrey Mfg. Co., The, Columbus, Ohio.
Link Belt Engr. Co., Phila., Pa.
Morse Chain Co., Trumansburg, N. Y.
Whitney Mfg. Co., Hartford, Ct.

Chucking Machines
Brown & Sharpe Mfg. Co., Providence, R. I.
Cleveland Automatic Mach. Co., Cleveland, O.
Le Blond Mach. Tool Co., R. K., Cincinnati, O.
Potter & Johnston Mach. Co., Pawtucket, R. I.
Pratt & Whitney Co., Hartford, Conn.
Reed Co., F. E., Worcester, Mass.
Warner & Swasey Co., Cleveland, Ohio.
Windsor Mach. Co., Windsor, Vt.

Chucks, Drill
Almond, T. R., Brooklyn, N. Y.
Brown & Co., R. H., New Haven, Conn.
Cleveland Twist Drill Co., Cleveland, O.
Cushman Chuck Co., Hartford, Ct.
Goodell-Pratt Co., Greenfield, Mass.
The E. Horton & Sons Co., Windsor Locks, Conn.
Morse Twist Drill & Mch. Co., New Bedford, Mass.
Pratt Chuck Co., Frankfort, N. Y.
Standard Tool Co., Cleveland, O.
Trump Bros. Mach. Co., Wilmington, Del.
Whitney Mfg. Co., Hartford, Ct.
Whiton Mach. Co., D. E., New London, Conn.

Chucks, Lathe
Cushman Chuck Co., Hartford, Ct.
Hoggson & Pettis Mfg. Co., New Haven, Conn.
The E. Horton & Son Co., Windsor Locks, Conn.
Pratt & Whitney Co., Hartford, Conn.
Skinner Chuck Co., New Britain, Conn.
Westcott Chuck Co., Oneida, N. Y.
Whiton Mach. Co., D. E., New London, Conn.

Chucks, Scroll
Whiton Mach. Co., D. E., New London, Conn.

Chucks, Split
Faneuil Watch Tool Co., Boston, Mass.
Hardinge Bros., Chicago, Ill.

Clutches, Friction
Caldwell, Son & Co., H. W., Chicago, Ill.
Coil Clutch Mfg. Co., New York.
Faneuil Watch Tool Co., Boston, Mass.
Jacobson Mach. Mfg. Co., Warren, Pa.
New Haven Mfg. Co., New Haven, Conn.
Oesterlein Mach. Co., Cincin., O.
Patterson, Gottfried & Hunter, Ltd., New York.
Pratt & Whitney Co., Hartford, Conn.

Compressors, Air
Blanchard Mach. Co., Boston, Mass.
Chicago Pneumatic Tool Co., Chicago, Ill.
Christensen Engineering Co., Milwaukee, Wis.
Clayton Air Compressor Works, New York.
Curtis & Co. Mfg. Co., St. Louis, Mo.
Gray-Blaisdell Co., Bradford, Pa.
Ingersoll-Sergeant Drill Co., New York.
Jacobson Mach. Mfg. Co., Warren, Pa.
Rand Drill Co., New York.

Consulting Engineer
Thompson, Hugh L., Waterbury, Conn.

Coping Machines
Cincinnati Punch & Shear Co., Cincinnati, O.
Long & Allstatter Co., Hamilton, Ohio.

Correspondence Schools
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Countershafts
Builders' Iron Fdry., Provl., R. I.
Oesterlein Mach. Co., Cincin., O.
Pratt & Whitney Co., Hartford, Conn.
Reeves Pulley Co., Columbus, Ind.
Wilmarth & Morman Co., Grand Rapids, Mich.

Counting and Printing Wheels
Franklin Mfg. Co., Syracuse, N. Y.

Coupler, Hose
Clark Co., W. J., Salem, O.

Couplings, Shaft
Caldwell & Son Co., H. W., Chicago, Ill.
Cresson Co., Geo. V., Philadel., Pa.
Davis Mach. Co., W. P., Rochester, N. Y.
Patterson, Gottfried & Hunter, Ltd., New York.
Stuart, R. J., New Hamburg, N. Y.
Vandegrift Coupling Co., Evansville, Ind.

Cranes
Brown Hoisting Mach. Co., N. Y. City.
Chicago Pneumatic Tool Co., Chicago, Ill.
Cleveland Crane & Car Co., Cleveland, O.
Curtis & Co. Mfg. Co., St. Louis, Mo.
Franklin Portable Crane & Hoist Co., Franklin, Pa.
Maris Bros., Philadelphia, Pa.
Niles-Bement-Pond Co., New York.
Northern Engineering Works, Detroit, Mich.
Pawling & Harnischfeger, Milwaukee, Wis.
Sellers & Co., Wm., Philadel., Pa.
Whiting Foundry Equipment Co., Harvey, Ill.

Crucibles
Dixon Crucible Co., Jos., Jersey City, N. J.

Cupolas, and Ladles, Foundry
Northern Engr. Works, Detroit, Mich.
Obermayer Co., S., Cincinnati, O.
Whiting Foundry Equip. Co., Harvey, Ill.

Cutters, Milling
Brown & Sharpe Mfg. Co., Providence, R. I.
Cleveland Twist Drill Co., Cleveland, O.
Gay & Ward, Athol, Mass.
Ingersoll Milling Mach. Co., Rockford, Ill.
Morse Twist Drill & Mach. Co., New Bedford, Mass.
Rogers, John M., Boat, Gage & Drill Works, Gloucester City, N. J.
Standard Tool Co., Cleveland, O.

Cutting-off Machines
Bement, Miles & Co., New York.
Brown & Sharpe Mfg. Co., Providence, R. I.
Davenport-McCullough Mfg. Co., Blissfield, Mich.
Davis Mach. Co., W. P., Rochester, N. Y.
Franklin Mach. Wks., Phila., Pa.
Hurlbut-Rogers Mach. Co., South Sudbury, Mass.
Newton Mach. Tool Wks., Philadelphia, Pa.
Niles Tool Works Co., New York.
Pond Mach. Tool Co., New York.

Cutting off Tools
Armstrong Bros. Tool Co., Chicago, Ill.
Pratt & Whitney Co., Hartford, Conn.

Diamond Tools
Dickinson, Thos. L., New York.

Dies, Threading, Opening
Errington, F. A., New York.
Geometric Drill Co., New Haven, Conn.
Jones & Lamson Mch. Co., Springfield, Vt.
Modern Tool Co., Erie, Pa.
Pratt & Whitney Co., Hartford, Conn.

Dies, Sheet Metal
Bliss Co., E. W., Brooklyn, N. Y.
Delivouk & George, Chicago, Ill.
Perkins Mach. Co., So. Boston, Mass.

Dowel Pins
Winkley Co., Hartford, Conn.

Drawing Instruments
Alteneder & Son, Theo., Philadelphia, Pa.
Keuffel & Esser Co., New York.
Rich, J. & G., Philadelphia, Pa.

Drilling Machines, Bench
Barnes Co., W. F. & John, Rockford, Ill.
Pratt & Whitney Co., Hartford, Conn.

Drilling Machines, Boiler
Aurora Tool Works, Aurora, Ind.
Baush Mch. Tool Co., Springfield, Mass.
Bickford Drill & Tool Co., Cincinnati, O.
Bement, Miles & Co., New York.
Dallett & Co., Thos. H., Phila., Pa.
Niles Tool Works Co., New York.
Pond Mach. Tool Co., New York.
Prentice Bros. Co., Worcester, Mass.

Drilling Machines, Multiple Spindle
Baker Bros., Toledo, O.
Barnes Co., B. F., Rockford, Ill.
Barnes Co., W. F. & John, Rockford, Ill.
Baush Mch. Tool Co., Springfield, Mass.
Bement, Miles & Co., New York.
Bickford Drill & Tool Co., Cincinnati, Ohio.
Dallett & Co., Thos. H., Phila., Pa.
Garvin Mach. Co., New York.
Harrington, Son & Co., Edwin, Philadelphia, Pa.
McCabe, J. J., New York.
Marshall & Huschart Mchry. Co., Chicago, Ill.
Newton Machine Tool Works, Philadelphia, Pa.
Niles Tool Works Co., New York.
Prentice Bros. Co., Worcester, Mass.
Prentiss Tool & Supply Co., New York.

Drilling Machines, Pneumatic
Chicago Pneumatic Tool Co., Chicago, Ill.
Cleveland Pneu. Tool Co., Cleveland, Ohio.
Phila. Pneumatic Tool Co., Philadelphia, Pa.
Q & C Co., Chicago, Ill.
Standard Ry. Equip. Co., St. Louis, Mo.

Drilling Machines, Portable
Dallett & Co., Thos. H., Phila., Pa.

Drilling Machines, Radial
American Tool Wks. Co., Cin., O.
Baush Mch. Tool Co., Springfield, Mass.
Bement, Miles & Co., New York.
Bickford Drill & Tool Co., Cincinnati, Ohio.
Cleveland Punch & Shear Works Co., Cleveland, O.
Dreses Mach. Tool Co., Cincin., O.
Fosdick Mach. Tool Co., Cincin., O.
Gang Co., Wm. E., Cincinnati, O.
Harrington, Son & Co., Edwin, Philadelphia, Pa.
Hill, Clarke & Co., Boston, Mass.
McCabe, J. J., New York.
Marshall & Huschart Mchry. Co., Chicago, Ill.
Mueller Mach. Tool Co., Cincin., O.
Niles Tool Works Co., New York.
Pond Mach. Tool Co., New York.
Prentice Bros. Co., Worcester, Mass.
Prentiss Tool & Supply Co., New York.
Reade Mchry Co., Cleveland, O.

Drilling Machines, Turret
Niles Tool Works Co., New York.
Quint, A. D., Hartford, Conn.
Vanderbeek Tool Wks., Hartford, Conn.

Drilling Machines, Upright
American Tool Wks. Co., Cin., O.
Aurora Tool Works, Aurora, Ind.
Baker Bros., Toledo, O.
Barnes Co., B. F., Rockford, Ill.
Barnes Co., W. F. & John, Rockford, Ill.
Bement, Miles & Co., New York.
Blaisdell & Co., P., Worcester, Mass.
Cincinnati Mach. Tool Co., Cin., O.
Davis Mach. Co., W. P., Rochester, N. Y.

Drilling Machines, Upright—*Cont'd*
Dwight Slate Mach. Co., Hartford, Conn.
Fosdick Mach. Tool Co., Cincinnati, O.
Gould & Eberhardt, Newark, N. J.
Harrington & Son Co., Edwin, Philadelphia, Pa.
Hill, Clarke & Co., Boston, Mass.
Hoefer Mfg. Co., Freeport, Ill.
Le Blond Mach. Tool Co., R. K., Cincinnati, O.
McCabe, J. J., New York.
Marshall & Huschart Mchry. Co., Chicago, Ill.
Niles Tool Works Co., New York.
New Haven Mfg. Co., New Haven, Conn.
Pratt & Whitney Co., Hartford, Conn.
Prentice Bros. Co., Worcester, Mass.
Prentiss Tool & Supply Co., New York.
Sibley & Ware, South Bend, Ind.
Washburn Shops, Worcester, Mass.

Drills, Center
Pratt & Whitney Co., Hartford, Conn.
Slocomb & Co., J. T., Providence, R. I.

Drills, Rail
Bement, Miles & Co., New York.
Niles Tool Works Co., New York.

Drills, Ratchet
Parker Co., Chas. Meriden, Ct.
Pratt & Whitney Co., Hartford, Conn.

Dynamos
Akron Elec. Mfg. Co., Akron, O.
C & C Electric Co., New York.
Crocker-Wheeler Electric Co., Ampere, N. J.
Eck Dynamo & Motor Co., Belleville, N. J.
General Elec. Co., New York.
Jantz & Leist Elec. Co., Cincin., O.
Mechanical Appliance Co., Milwaukee, Wis.
Northern Elec. Mfg. Co., Madison, Wis.
Robbins & Myers Co., Springfield, Ohio.
Roth Bros. & Co., Chicago, Ill.
Sprague Elec. Co., New York.
Triumph Elec. Co., Cincinnati, O.
Western Electric Co., Chicago, Ill.
Westinghouse Electric & Mfg. Co., Pittsburgh, Pa.

Electrical Supplies
Akron Elec. Mfg. Co., Akron, O.
General Elec. Co., New York.
Triumph Electric Co., Cincin., O.
Western Electric Co., Chicago, Ill.
Westinghouse Elec. & Mfg. Co., Pittsburgh, Pa.

Elevators
Albro-Clem Elevator Co., Philadelphia, Pa.
Curtis & Co. Mfg. Co., St. Louis, Mo.
Morse, Williams & Co., Phila., Pa.

Emery Wheels
See Grinding Wheels.

Enclosures, Tool-room
Merritt & Co., Philadelphia, Pa.

Engines, Gas and Gasoline
Backus Water Motor Co., Newark, N. J.
Columbus Mach. Co., Columbus, O.
Cooper Mach. Co., Saltsburg, Pa.
Elyria Engine Co., Elyria, O.
Foos Gas Eng. Co., Springfield, O.
Mietz, August, New York.
National Engine Co., Rockford, Ill.
New England Gas Engine Co., Boston, Mass.
New Era Iron Wks., Dayton, O.
Olds Motor Wks., Lansing, Mich.
Patterson, Gottfried & Hunter, Ltd., New York.
Regal Gasoline Engine Co., Coldwater, Mich.
Springfield Gas Eng. Co., Springfield, O.
Stover Engine Works, Freeport, Ill.
Struthers, Wells & Co., Warren, Pa.

Engines, Steam
Buffalo Forge Co., Buffalo, N. Y.
Frick Co., Waynesboro, Pa.
Rand Drill Co., New York.
Struthers, Wells & Co., Warren, Pa.

Exhaust Fans
Buffalo Forge Co., Buffalo, N. Y.

Exhaust Heads
Burt Mfg. Co., Akron, O.

Fans, Electric
General Electric Co., New York.
Northern Elec. Mfg. Co., Madison, Wis.
Sprague Elec. Co., New York.
Western Electric Co., Chicago, Ill.
Westinghouse Elec. & Mfg. Co., Pittsburgh, Pa.

Files and Rasps
Barnett Co., G. & H., Phila., Pa.
Etna Mfg. Co., New York.
Hammacher, Schlemmer & Co., New York.
Nicholson File Co., Provl., R. I.
Troy File Works, Troy, N. Y.

Filing Machines
Cochrane-Bly Mach. Co., Rochester, N. Y.

Fillers, Oil Can
The Winkley Co., Hartford, Conn.

Filters, Oil
Burt Mfg. Co., Akron, O.

Fittings, Steam
Crane Co., Chicago, Ill.
Crosby Steam Gage & Valve Co., Boston, Mass.
Jenkins Bros., New York.
Lunkenheimer Co., Cincinnati, O.
Walworth Mfg. Co., Boston, Mass.

Flexible Shafts
Chicago Flexible Shaft Co., Chicago, Ill.

Forges
Buffalo Forge Co., Buffalo, N. Y.

Forgings, Drop
Billings & Spencer Co., Hartford, Conn.
Wyman & Gordon, Worcester, Mass.

Forgings, Hydraulic
Wyman & Gordon, Worcester, Mass.

Forgings, Steel
Westmoreland Steel Co., Pittsburgh, Pa.
Wyman & Gordon, Worcester, Mass.

Foundry Furnishings
Obermayer Co., S., Cincinnati, O.
Whiting Foundry Equip. Co., Harvey, Ill.

Furnaces, Coal, Gas and Oil
Am. Gas Furnace Co., N. Y. City.
Buffalo Forge Co., Buffalo, N. Y.
Chicago Flexible Shaft Co., Chicago, Ill.
Jacobson Mach. Mfg. Co., Warren, Pa.

Furniture, Machine Shop
New Britain Mach. Co., New Britain, Conn.

Gages, Recording
Bristol Co., Waterbury, Conn.

Gages, Standard
Brown & Sharpe Mfg. Co., Providence, R. I.
Rogers, John M., Boat, Gage & Drill Works, Gloucester City, N. J.
Sawyer Tool Mfg. Co., Fitchburg, Mass.
Slocomb & Co., J. T., Prov., R. I.
Starrett Co., L. S., Athol, Mass.

Gages, Steam
Crosby Steam Gage & Valve Co., Boston, Mass.

Gas Producers
Am. Gas Furnace Co., N. Y. City.

Gear Cutting Machinery
Bickford Drill & Tool Co., Cin., O.
Brown & Sharpe Mfg. Co., Providence, R. I.
Fellows Gear Shaper Co., Springfield, Vt.
Gleason Tool Co., Rochester, N. Y.
Gould & Eberhardt, Newark, N. J.
Harrington & Son Co., Edwin, Philadelphia, Pa.
Newton Mch. Tool Wks., Phil., Pa.
Niles Tool Works Co., New York.
Whiton Machine Co., D. E., New London, Conn.

Gears, Cut
Bilgram, Hugo, Philadelphia, Pa.
Boston Gear Wks., Boston, Mass.
Brown & Sharpe Mfg. Co., Providence, R. I.
Cleveland Gear Wks., Cleveland, O.
Fawcus Mach. Co., Pittsburgh, Pa.
Fellows Gear Shaper Co., Springfield, Vt.
Ganschow, Wm., Chicago, Ill.
Gleason Tool Co., Rochester, N. Y.
Gould & Eberhardt, Newark, N. J.
Grant Gear Works, Boston, Mass.
Harrington, Son & Co., Edwin, Philadelphia, Pa.
Horsburgh & Scott, Cleveland, O.
New Process Raw Hide Co., Syracuse, N. Y.
N. Y. Gear Works, New York.
Nuttall Co., R. D., Pittsburgh, Pa.
Philadelphia Gear Works, Philadelphia, Pa.
Simonds Mfg. Co., Pittsburgh, Pa.

Gears, Molded
Caldwell & Son Co., H. W., Chicago, Ill.
Franklin Mfg. Co., Syracuse, N. Y.
Greenwald Co., I. & E., Cincin., O.
Poole & Son Co., Robt., Baltimore, Md.

Gears, Rawhide
Chicago Raw Hide Co., Chicago, Ill.
Fawcus Mch. Co., Pittsburgh, Pa.
New Process Raw Hide Co., Syracuse, N. Y.
Nuttall Co., R. D., Pittsburgh, Pa.

Gears, Worm
Albro-Clem Elevator Co., Philadelphia, Pa.
Fawcus Mach. Co., Pittsburgh, Pa.
Morse, Williams & Co., Phila., Pa.
Nuttall Co., R. D., Pittsburgh, Pa.
Simonds Mfg. Co., Pittsburgh, Pa.

Graphite
Dixon Crucible Co., Jos., Jersey City, N. J.
Lubriphite Co., Jersey City, N. J.
Obermayer Co., S., Cincinnati, O.

Grinders, Center
Heald & Son, L. S., Barre, Mass.

Grinders, Cock
Windsor Mach. Co., Windsor, Vt.

Grinders, Cutter
Adams Co., Dubuque, Iowa.
Automatic Mach. Co., Greenfield, Mass.
Brown & Sharpe Mfg. Co., Providence, R. I.
Cincinnati Milling Mach. Co., Cincinnati, O.
Garvin Machine Co., New York.
Norton Emery Wheel Co., Worcester, Mass.
Oesterlein Mach. Co., Cincin., O.
Pratt & Whitney Co., Hartford, Conn.
Rivett-Dock Co., Boston, Mass.

Grinders, Disc
Baylon Mach. & Tool Co., Jersey City, N. J.
Besly & Co., Chas. H., Chicago, Ill.
Gorton Mach. Co., Geo., Racine, Wis.
Iroquois Mach. Co., Provi., R. I.
Ransom Mfg. Co., Oshkosh, Wis.

Grinders, Drill
Gorton Mach. Co., Geo., Racine, Wis.
Heald & Son, L. S., Barre, Mass.
Standard Tool Co., Cleveland, O.
Washburn Shops, Worcester, Mass.
Wilmarth & Morman Co., Grand Rapids, Mich.

Grinders, Tool
Barnes Co., B. F., Rockford, Ill.
Barnes Co., W. F. & John, Rockford, Ill.
Brown & Sharpe Mfg. Co., Providence, R. I.
Diamond Mach. Co., Prov., R. I.
Gisholt Mach. Co., Madison, Wis.
Iroquois Mach. Co., Provi., R. I.
Landis Tool Co., Waynesboro, Pa.
Modern Tool Co., Erie, Pa.
Northampton Emery Wheel Co., Leeds, Mass.
Oesterlein Mach. Co., Cincin., O.
Ransom Mfg. Co., Oshkosh, Wis.
Safety Emery Wheel Co., Springfield, O.
Whitney Mfg. Co., Hartford, Ct.

Grinding Machines
Besly & Co., Chas. H., Chicago, Ill.
Brown & Sharpe Mfg. Co., Providence, R. I.
Builders' Iron Foundry, Providence, R. I.
Diamond Mach. Co., Prov., R. I.
Falkenau-Sinclair Co., Phila., Pa.
Frasse Co., New York.
Goodell-Pratt Co., Greenfield, Mass.
Gorton Mach. Co., Geo., Racine, Wis.
Greenfield Mach. Co., Greenfield, Mass.
Hill, Clarke & Co., Boston, Mass.
Iroquois Mach. Co., Prov., R. I.
Landis Tool Co., Waynesboro, Pa.
Marshall & Huschart Mchry. Co., Chicago, Ill.
Northampton Emery Wheel Co., Leeds, Mass.
Northern Elec. Mfg. Co., Madison, Wis.
Norton Emery Wheel Co., Worcester, Mass.
Prentiss Tool & Supply Co., New York.
Ransom Mfg. Co., Oshkosh, Wis.
Safety Emery Wheel Co., Springfield, Ohio.
Tanite Co., Stroudsburg, Pa.
Vitrified Wheel Co., Westfield, Mass.
Washburn Shops, Worcester, Mass.
Webster & Perks Tool Co., Springfield, O.
Wilmarth & Morman Co., Grand Rapids, Mich.

Grinding Wheels
Abrasive Material Co., Phila., Pa.
Builders' Iron Foundry, Providence, R. I.
Carborundum Co., Niagara Falls, N. Y.
Diamond Mach. Co., Provi., R. I.
Hampden Cor. Wheel Co., Brightwood, Mass.
Northampton Emery Wheel Co., Leeds, Mass.
Norton Emery Wheel Co., Worcester, Mass.
Safety Emery Wheel Co., Springfield, O.
Tanite Co., Stroudsburg, Pa.
Vitrified Wheel Co., Westfield, Mass.

Grindstones
Lombard & Co., Boston, Mass.

Gun Barrel Machinery
Bement, Miles & Co., New York.
Diamond Mach. Co., Provi., R. I.
Niles Tool Works Co., New York.
Pond Mach. Tool Co., New York.
Reed Co., F. E., Worcester, Mass.

Hack Saw Blades and Frames
Goodell-Pratt Co., Greenfield, Mass.
Hammacher, Schlemmer & Co., New York.
Millers Falls Co., New York.
Starrett Co., L. S., Athol, Mass.
West Haven Mfg. Co., New Haven, Conn.

Hack Saws, Power
Frasse Co., New York.
Hoefer Mfg. Co., Freeport, Ill.
Millers Falls Co., New York.
West Haven Mfg. Co., New Haven, Conn.

Hammers, Drop
Bement, Miles & Co., New York.
Billings & Spencer Co., Hartford, Conn.
Bliss Co., E. W., Brooklyn, N. Y.
Iroquois Machine Co., Providence, R. I.
Mossberg & Granville Mfg. Co., Providence, R. I.
Perkins Mach. Co., Boston, Mass.

Hammers, Pneumatic
Chicago Pneumatic Tool Co., Chicago, Ill.
Cleveland Pneumatic Tool Co., Cleveland, O.
Dallett & Co., Thos. H., Phila., Pa.
Phila. Pneu. Tool Co., Philadelphia, Pa.
Q. & C. Co., Chicago, Ill.
Standard Ry. Equip. Co., St. Louis, Mo.

Hammers, Power
Scranton & Co. The, New Haven, Conn.

Hammers, Steam
Bement, Miles & Co., New York.
Bethlehem Fdry. & Mach. Co., So. Bethlehem, Pa.
Chambersburg Engr. Co., Chambersburg, Pa.
Cleveland Punch & Shear Wks. Co., Cleveland, O.
Pittsburg Shear Knife & Mach. Co., Pittsburg, Pa.

Heating Machines, Automatic
Am. Gas Furnace Co., New York.

Heating and Ventilating Apparatus
Buffalo Forge Co., Buffalo, N. Y.

Hoisting and Conveying Machinery
Brown Hoisting Mchry. Co., New York.
Caldwell & Son Co., H. W., Chicago, Ill.
Hunt Co., C. W., West New Brighton, N. Y.
Link Belt Engineering Co., Philadelphia, Pa.
Niles-Bement-Pond Co., New York.

Hoists, Electric
C & C Electric Co., New York.
Hunt Co., C. W., West New Brighton, N. Y.
Northern Engineering Works, Detroit, Mich.
Pawling & Harnischfeger, Milwaukee, Wis.
Sprague Electric Co., New York.

Hoists, Hand
Harrington, Son & Co., Edwin, Philadelphia, Pa.
Yale & Towne Mfg. Co., New York.

Hoists, Pneumatic
Chicago Pneumatic Tool Co., Chicago, Ill.
Cleveland Pneumatic Tool Co., Cleveland, O.
Curtis & Co. Mfg. Co., St. Louis, Mo.
Northern Engineering Wks., Detroit, Mich.
Rand Drill Co., New York.

Indicators, Speed
Starrett Co., L. S., Athol, Mass.

Indicators, Steam
Crosby Steam Gage & Valve Co., Boston, Mass.

Indicators, Test
Lowe, H. A., Waltham, Mass.

Injectors
Lunkenheimer Co., Cincinnati, O.
Sellers & Co., Wm., Phila., Pa.

Inspection and Tests
Hunt Co., Robt. W., Chicago, Ill.

Instruction Schools
See Schools, Correspondence.

Jacks, Hydraulic
Bethlehem Fdry & Mch. Co., So. Bethlehem, Pa.
Watson-Stillman Co., New York.

Key Seaters
Baker Bros., Toledo, O.
Bement, Miles & Co., New York.
Chattanooga Mchry. Co., Chattanooga, Tenn.
Davis Mach. Co., W. P., Rochester, N. Y.
Mitts & Merrill, Saginaw, Mich.

Keys, Machine
Standard Gauge Steel Co., Beaver Falls, Pa.
Whitney Mfg. Co., Hartford, Ct.

Lamps, Arc
General Electric Co., N. Y. City.
Western Electric Co., Chicago, Ill.
Westinghouse Elec. & Mfg. Co., Pittsburgh, Pa.

Lathes
American Tool Wks. Co., Cin., O.
Auto. Mach. Co., Bridgeport, Ct.
Automatic Mach. Co., Greenfield, Mass.
Barker & Co., Wm., Cincinnati, O.
Barnes Co., B. F., Rockford, Ill.
Barnes Co., W. F. & John, Rockford, Ill.
Bement, Miles & Co., New York.
Blaisdell & Co., P., Worcester, Mass.
Bradford Mach. Tool Co., Cin., O.
Bullard Mach. Tool Co., Bridgeport, Conn.

Lathes—*Continued*
Davis Mach. Co., W. P., Rochester, N. Y.
Diamond Machine Co., Provi., R. I.
Fay & Scott, Dexter, Me.
Flather & Co., Nashua, N. H.
Frasse Co., New York.
Garvin Mach. Co., New York.
Greaves, Klusman & Co., Cincinnati, O.
Harrington, Son & Co., Edwin, Philadelphia, Pa.
Hendey Mach. Co., Torrington, Ct.
Hill, Clarke & Co., Boston, Mass.
Le Blond Mach. Tool Co., R. K., Cincinnati, O.
Lodge & Shipley Mch. Tool Co., Cincinnati, O.
McCabe, J. J., Nw York.
Marshall & Huschart Mchry. Co., Chicago, Ill.
New Haven Mfg. Co., New Haven, Conn.
Niles Tool Works Co., New York.
Pond Mach. Tool Co., New York.
Pratt & Whitney Co., Hartford, Conn.
Prentice Bros. Co., Worcester, Mass.
Prentiss Tool & Supply Co., New York.
Reed Co., F. E., Worcester, Mass.
Schumacher & Boye, Cincinnati, Ohio.
Sebastian Lathe Co., Cincin., O.
Seneca Falls Mfg. Co., Seneca Falls, N. Y.
Shepard Lathe Co., Cincinnati, O.
Tanite Co., Stroudsburg, Pa.
Washburn Shops, Worcester, Mass.

Lathe Attachments
Baylon Mach. & Tool Co., Jersey City, N. J.

Lathe Dogs
Armstrong Bros. Tool Co., Chicago, Ill.
Besly & Co., Chas. H., Chicago, Ill.
Hill Tool Co., Anderson, Ind.
Le Count, Wm. G., So. Norwalk, Conn.
Pratt & Whitney Co., Hartford, Conn.

Lathes, Automatic Screw-Threading
Automatic Machine Co., Bridgeport, Conn.

Lathes, Bench
Faneuil Watch Tool Co., Boston, Mass.
Hardinge Bros., Chicago, Ill.
Waltham Watch Tool Co., Springfield, Mass.

Lathes, Wood
American Machinery Co., Grand Rapids, Mich.

Letters, Pattern
Butler, A. G., N. Y. City.

Levels
Mass. Tool Co., Greenfield, Mass.
Starrett Co., L. S., Athol, Mass.

Lockers, Clothes
Merritt & Co., Philadelphia, Pa.
Narragansett Mach. Co., Providence, R. I.

Locomotives, Shop
Hunt Co., C. W., West New Brighton, N. Y.

Lubricants
Besly & Co., Chas. H., Chicago, Ill.
Dixon Crucible Co., Jos., Jersey City, N. J.
Lubriphite Co., Jersey City, N. J.

Lubricators
Besly & Co., Chas. H., Chicago, Ill.
Bowen Mfg. Co., Auburn, N. Y.
Crane Co., Chicago, Ill.
Lubriphite Co., Jersey City, N. J.
Lunkenheimer Co., Cincinnati, O.

Machine Screws
Atlantic Mach. Screw Co., Boston, Mass.
Worcester Mach. Screw Co., Worcester, Mass.

Machinery Builders, Special
American Fdry. & Mach. Co., Hanover, Pa.
Atlas Foundry & Mach. Co., Belleville, N. J.
Blanchard Mach. Co., The, Boston, Mass.
Fawcus Mch. Co., Pittsburgh, Pa.
Pratt & Whitney Co., Hartford, Conn.
Simonds Mfg. Co., Pittsburgh, Pa.

Machinists' Small Tools
Besly & Co., Chas. H., Chicago, Ill.
Billings & Spencer Co., Hartford, Conn.
Brown & Sharpe Mfg. Co., Providence, R. I.
Cleveland Twist Drill Co., Cleveland, O.
Hammacher, Schlemmer & Co., New York.
Mass. Tool Co., Greenfield, Mass.
McCrosky & Huber, Cincinnati, O.
Patterson, Gottfried & Hunter, Ltd., New York.
Sawyer Tool Mfg. Co., Fitchburg, Mass.
Slocomb & Co., J. T., Provi., R. I.
Starrett Co., L. S., Athol, Mass.

Mandrels, Expanding
Nicholson & Son, W. H., Wilkesbarre, Pa.

Mandrels, Solid
Cleveland Twist Drill Co., Cleveland, O.
Morse Twist Drill & Mach. Co., New Bedford, Mass.
Rogers, John M., Boat, Gage & Drill Works, Gloucester City, N. J.
Standard Tool Co., Cleveland, O.

Measuring Machines
Rogers, John M., Boat, Gage & Drill Works, Gloucester City, N. J.

Micrometer Calipers
Brown & Sharpe Mfg. Co., Providence, R. I.
Sawyer Tool Mfg. Co., Fitchburg, Mass.
Slocomb & Co., J. T., Providence, R. I.
Starrett Co., L. S., Athol, Mass.

Milling Attachments
The Adams Co., Dubuque, Iowa.
Brown & Sharpe Mfg. Co., Providence, R. I.
Cincinnati Milling Mach. Co., Cincinnati, O.
Kempsmith Mfg. Co., Milwaukee, Wis.
Oesterlein Mach. Co., Cincin., O.

Milling Machines, Bench
Faneuil Watch Tool Co., Boston, Mass.
Hill, Clarke & Co., Boston, Mass.
Waltham Watch Tool Co., Springfield, Mass.

Milling Machines, Horizontal
Adams Co., Dubuque, Iowa.
Beaman & Smith Co., Prov., R. I.
Bement, Miles & Co., New York.
Franklin Mach. Wks., Phila., Pa.
Hendey Mach. Co., Torrington, Ct.
Ingersoll Mill. Mach. Co., Rockford, Ill.
Newton Mach. Tool Wks., Philadelphia, Pa.
Niles Tool Works Co., New York.
Pratt & Whitney Co., Hartford, Conn.

Milling Machines, Plain
American Tool Wks. Co., Cin., O.
Aurora Tool Works, Aurora, Ind.
Bement, Miles & Co., New York.
Brown & Sharpe Mfg. Co., Providence, R. I.
Cincinnati Milling Mach. Co., Cincinnati, O.
Garvin Mach. Co., New York.
Hendey Mach. Co., Torrington, Ct.
Hill, Clarke & Co., Boston, Mass.
Kempsmith Mfg. Co., Milwaukee, Wis.
Le Blond Mach. Tool Co., R. K., Cincinnati, O.
Marshall & Huschart Mchry Co., Chicago, Ill.
McCabe, J. J., New York.
Oesterlein Mach. Co., Cincin., O.
Owen Mach. Tool Co., Springfield, Ohio.
Prentiss Tool & Supply Co., New York.
Whitney Mfg. Co., Hartford, Ct.

Milling Machines, Portable
Underwood & Co., H. B., Philadelphia, Pa.

Milling Machines, Vertical
Bement, Miles & Co., New York.
Brown & Sharpe Mfg. Co., Providence, R. I.
Garvin Mach. Co., New York.
Ingersoll Mill. Mach. Co., Rockford, Ill.
Newton Mch. Tool Works, Philadelphia, Pa.
Niles Tool Works Co., New York.
Owen Mach. Tool Co., Springfield, Ohio.
Pratt & Whitney Co., Hartford, Conn.

Milling Machines, Universal
American Tool Wks. Co., Cin., O.
Aurora Tool Works, Aurora, Ind.
Bement, Miles & Co., New York.
Brown & Sharpe Mfg. Co., Providence, R. I.
Cincinnati Milling Mach. Co., Cincinnati, O.
Garvin Mach. Co., New York.
Hendey Mach. Co., Torrington, Ct.
Hill, Clarke & Co., Boston, Mass.
Kempsmith Mfg. Co., Milwaukee, Wis.
Le Blond Mach. Tool Co., R. K., Cincinnati, O.
Marshall & Huschart Mchry. Co., Chicago, Ill.
McCabe, J. J., New York.
Niles Tool Works Co., New York.
Oesterlein Mach. Co., Cincin., O.
Owen Mach. Tool Co., Springfield, Ohio.
Prentiss Tool & Supply Co., New York.
Waltham Watch Tool Co., Springfield, Mass.

Milling Tools, Adjustable
Geometric Drill Co., New Haven, Conn.
Rogers, Boat, Gage & Drill Wks., John M., Gloucester City, N. J.

Molding Machines
The Adams Co., Dubuque, Iowa.
American Foundry & Mach. Co., Hanover, Pa.
Tabor Mfg. Co., Philadelphia, Pa.
Webster & Perks Tool Co., Springfield, O.

Motors, Electric
Akron Elec. Mfg. Co., Akron, O.
C & C Electric Co., New York.
Christensen Engr. Co., Milwaukee, Wis.
Crocker-Wheeler Co., Ampere, N. J.
Eck Dynamo & Motor Wks., Belleville, N. J.
General Electric Co., New York.
Jantz & Leist Elec. Co., Cin., O.
Mechanical Appliance Co., Milwaukee, Wis.
Northern Elec. Mfg. Co., Madison, Wis.
Robbins & Myers Co., Springfield, Ohio.
Roth Bros. & Co., Chicago, Ill.
Sprague Electric Co., New York.
Triumph Elec. Co., Cincinnati, O.
Western Electric Co., Chicago, Ill.
Westinghouse Elec. & Mfg. Co., Pittsburgh, Pa.

Nail Machinery, Wire
National Machy. Co., Tiffin, O.

Name Plates
Engraving Co., G. & P., Boston, Mass.
Franklin Mfg. Co., Syracuse, N. Y.
Murdock Parlor Grate Co., Boston, Mass.

Nut Tappers
See Bolt and Nut Machinery.

Oils
Besly & Co., Chas. H., Chicago, Ill.
Houghton & Co., E. F., Philadelphia, Pa.

Oil Cups and Covers
Bay State Stamping Works, Worcester, Mass.
Besly & Co., Chas. H., Chicago, Ill.
Bowen Mfg. Co., Auburn, N. Y.
Crane Co., Chicago, Ill.
Lunkenheimer Co., Cincinnati, O.
The Winkley Co., Hartford, Conn.

Packing, Steam Joint
Jenkins Bros., New York.

Pans, Lathe
New Britain Mch. Co., New Britain, Conn.

Patents
Baldwin, Davidson & Wight, Washington, D. C.
Frothingham, N. L., New York.
Straley, Hasbrouck & Schloeder, New York.

Pattern Shop Machinery
American Machinery Co., Grand Rapids, Mich.
Baker Bros., Toledo, O.
Fay & Scott, Dexter, Me.
Greaves, Klusman & Co., Cin., O.
Prentiss Tool & Supply Co., New York.
Washburn Shops, Worcester, Mass.

Patterns, Wood
Gobeille Pattern Co., Cleveland, O.

Pencils
Keuffel & Esser Co., New York.

Phosphor Bronze
Phosphor Bronze Smelting Co., Philadelphia, Pa.

Pipe and Fittings
Crane Co., Chicago, Ill.

Pipe Cutting and Threading Machines
Curtis & Curtis Co., Bridgeport, Conn.
Merrell Mfg. Co., Toledo, O.
Saunders' Sons, D., Yonkers, N. Y.
Wells Bros. Co., Greenfield, Mass.

Pipe Fitters' Tools
Cleveland Twist Drill Co., Cleveland, O.
Saunders' Sons, D., Yonkers, N. Y.
Standard Tool Co., Cleveland, O.

Planer, Jack
Armstrong Bros. Tool Co., Chicago, Ill.

Planers
American Tool Wks. Co., Cin., O.
Belmer Mach. Tool Co., Cin., O.
Bement, Miles & Co., New York.
Betts Mach. Co., Wilmington, Del.
Cincinnati Planer Co., Cincin., O.
Detrick & Harvey Mch. Co., Baltimore, Md.
Flather Planer Co., Mark, Nashua, N. H.
Garvin Mach. Co., New York.
Gray Co., G. A., Cincinnati, O.
Harrington, Son & Co., Edwin, Philadelphia, Pa.
Hendey Mach. Co., Torrington, Ct.
Hill, Clarke & Co., Boston, Mass.
McCabe, J. J., New York.
Niles Tool Works Co., New York.
New Haven Mfg. Co., New Haven, Conn.
Pond Mach. Tool Co., New York.
Prentiss Tool & Supply Co., New York.
Sellers & Co., Wm., Phila., Pa.
Whitcomb Mfg. Co., Worcester, Mass.
Woodward & Powell Planer Co., Worcester, Mass.

Planers, Bench
Bartlett, E. E., Boston, Mass.

Planers, Portable
Morton Mfg. Co., Muskegon Heights, Mich.

Planers, Rotary
Bement, Miles & Co., New York.
Cleveland Punch & Shear Works, Cleveland, O.
Franklin Mach. Wks., Phila., Pa.
Newton Mach. Tool Wks., Philadelphia, Pa.
Pond Mach. Tool Co., New York.

Presses, Hand
Elmes Eng. Co., Chas. F., Chicago, Ill.

Presses, Hydraulic
Bement, Miles & Co., New York.
Elmes Eng. Co., Chas. F., Chicago, Ill.
Watson-Stillman Co., New York.

Presses, Power
Automatic Mach. Co., Bridgeport, Conn.
Bethlehem Fdry. & Mch. Co., So. Bethlehem, Pa.
Bliss Co., E. W., Brooklyn, N. Y.
Delivouk & George, Chicago, Ill.
Dill Mach. Co., T. C., Phila., Pa.
Mossberg & Granville Mfg. Co., Providence, R. I.
Perkins Mach. Co., Boston, Mass.
Prentiss Tool & Supply Co., New York.

Profilers
Garvin Mach. Co., New York.
Pratt & Whitney Co., Hartford, Conn.

Pulley Turning and Boring Machines
American Tool Wks. Co., Cin., O.
Harrington, Son & Co., Edwin, Philadelphia, Pa.
New Haven Mfg. Co., New Haven, Conn.
Niles Tool Works Co., New York.

Pulleys
American Pulley Co., Phila., Pa.
Caldwell & Son Co., H. W., Chicago, Ill.
Cresson Co., Geo. V., Phila., Pa.
Poole & Son Co., Robt., Baltimore, Md.
Reeves Pulley Co., Columbus, Ind.

Pulleys, Friction Cone
Evans Friction Cone Co., Boston, Mass.

Pulleys, Speed Changing
Speed Changing Pulley Co., Indianapolis, Ind.

Pumps, Hydraulic
Elmes Eng. Wks., Chas. F., Chicago, Ill.
Watson-Stillman Co., New York.

Punches, Hydraulic
Bement, Miles & Co., New York.
Bethlehem Fdry. & Mch. Co., So. Bethlehem, Pa.
Watson-Stillman Co., New York.

Punches, Power
Bliss Co., E. W., Brooklyn, N. Y.
Bremer Mach. & Tool Co., Kalamazoo, Mich.
Buffalo Forge Co., Buffalo, N. Y.
Cincinnati Punch & Shear Co., Cincinnati, O.
Cleveland Punch & Shear Wks., Cleveland, O.
Hilles & Jones Co., Wilmington, Del.
Long & Allstatter Co., Hamilton, Ohio.
Perkins Mach. Co., So. Boston, Mass.
Pittsburg Shear Knife & Mach. Co., Pittsburg, Pa.
Reade Mchry Co., Cleveland, O.

Rack Cutting Machines
Fellows Gear Shaper Co., Springfield, Vt.
Le Blond Mach. Tool Co., R. K., Cincinnati, O.
Reed Co., F. E., Worcester, Mass.

Racks, Cut
Fellows Gear Shaper Co., Springfield, Vt.
Nuttall Co., R. D., Pittsburgh, Pa.
Simonds Mfg. Co., Pittsburgh, Pa.
Standard Gauge Steel Co., Beaver Falls, Pa.

Racks, Tool
New Britain Mach. Co., New Britain, Conn.

Reamers
Chadwick & Co., G. B., Portsmouth, N. H.
Cleveland Twist Drill Co., Cleveland, O.
Clough, R. M., Tolland, Conn.
McCrosky & Huber, Cincinnati, O.
Morse Twist Drill & Mach. Co., New Bedford, Mass.
Pratt & Whitney Co., Hartford, Conn.
Rogers, John M., Boat, Gage & Drill Works, Gloucester City, N. J.
Standard Tool Co., Cleveland, O.
Wells Bros. Co., Greenfield, Mass.

Reaming Stands
Flather Planer Co., Mark, Nashua, N. H.

Riveters, Hydraulic
Bement, Miles & Co., New York.
Watson-Stillman Co., New York.

Riveters, Pneumatic
Bement, Miles & Co., New York.
Cleveland Pneumatic Tool Co., Cleveland, O.
Philadelphia Pneumatic Tool Co., Philadelphia, Pa.
Q & C Co., Chicago, Ill.
Standard Ry. Equip. Co., St. Louis, Mo.

Riveting Machines
Bement, Miles & Co., New York.
Bethlehem Foundry & Mach. Co., So. Bethlehem, Pa.
Chambersburg Engr. Co., Chambersburg, Pa.
Long & Allstatter Co., Hamilton, Ohio.
Perkins Mach. Co., So. Boston, Mass.

Rods and Straps, Connecting
Standard Connecting Rod Co., Beaver Falls, Pa.

Rolling Mill Machinery
Cincinnati Punch & Shear Co., Cincinnati, O.
Cleveland Punch & Shear Wks. Co., Cleveland, O.
Diamond Drill & Mch. Co., Birdsboro, Pa.
Dill Mach. Co., T. C., Phila., Pa.
Hilles & Jones Co., Wilmington, Del.
Iroquois Mach. Co., Providence, R. I.
Mossberg & Granville Mfg. Co., Providence, R. I.
Pratt & Whitney Co., Hartford, Conn.

Rolls, Bending
Hilles & Jones Co., Wilmington, Del.
Perkins Mach. Co., So. Boston, Mass.

Roller and Ball Bearings
American Roller Bearing Co., Boston, Mass.
Ball Bearing Co., Philadel., Pa.
Iroquois Mach. Co., Providence, R. I.
Mossberg & Granville Mfg. Co., Providence, R. I.

Rules, Steel
Mass. Tool Co., Greenfield, Mass.
Sawyer Tool Co., Fitchburg, Mass.
Starrett Co., L. S., Athol, Mass.

Safety Valves, Pop
Crane Co., Chicago, Ill.
Crosby Steam Gage & Valve Co., Boston, Mass.
Lunkenheimer Co., Cincinnati, O.

Sawing Machines, Metal
Cleveland Punch & Shear Works Co., Cleveland, O.
Cochrane-Bly Mach. Works, Rochester, N. Y.
Newton Mach. Tool Works, Philadelphia, Pa.
Pratt & Whitney Co., Hartford, Conn.
Reade Mchry. Co., Cleveland, O.

Sawing Machines, Wood
American Machinery Co., Grand Rapids, Mich.

Schools, Correspondence
Amer. School of Correspondence, Boston, Mass.
Consolidated Schools, N. Y. City.
International Correspond. Schools, Scranton, Pa.

Screw Machines, Automatic
Brown & Sharpe Mfg. Co., Providence, R. I.
Cleveland Automatic Mach. Co., Cleveland, Ohio.
Dreses Mach. Tool Co., Cincin., O.
Marshall & Huschart Mchry. Co., Chicago, Ill.
Windsor Mach. Co., Windsor, Vt.

Screw Machines, Hand
Brown & Sharpe Mfg. Co., Providence, R. I.
Cleveland Automatic Mach. Co., Cleveland, O.
Garvin Mach. Co., New York.
Jones & Lamson Mch. Co., Springfield, Vt.
Pearson Mach. Co., Chicago, Ill.
Potter & Johnston Mach. Co., Pawtucket, R. I.
Pratt & Whitney Co., Hartford, Conn.
Warner & Swasey Co., Cleveland, Ohio.
Windsor Mach. Co., Windsor, Vt.

Screw Machinery, Wood and Lag
Baker Bros., Toledo, Ohio.
Cook Co., Asa S., Hartford, Conn.

Screw Plates
Besly & Co., Chas. H., Chicago, Ill.
Carpenter Tap & Die Co., J. M., Pawtucket, R. I.
Card Mfg. Co., S. W., Mansfield, Mass.
Hart Mfg. Co., Cleveland, O.
Morse Twist Drill & Mach. Co., New Bedford, Mass.
Wells Bros. Co., Greenfield, Mass.
Wiley & Russell Mfg. Co., Greenfield, Mass.

Second Hand Machinery
Affleck, Geo. E., New York.
Baird Machy. Co., Pittsburgh, Pa. Pa.
Bowler & Co., Geo. H., Cleveland, Ohio.
Carlin Mchry. & Supply Co., Allegheny, Pa.
Dawson, John H., Chicago, Ill.
Fairbanks Co., Philadelphia, Pa.
Garvin Mch. Co., New York.
Hill, Clarke & Co., Boston, Mass.
Marshall & Huschart Mchry. Co., Chicago, Ill.
McCabe, J. J., New York.
Niles Tool Works Co., New York.
Pratt & Whitney Co., Hartford, Conn.
Prentiss Tool & Supply Co., New York.
Toomey, Frank, Philadelphia, Pa.
Wormer Machy. Co., C. C., Detroit, Mich.

Separators, Magnetic
Sawyer, Ezra, Worcester, Mass.

Separators, Oil
Springfield Separator Co., Manchester, N. H.

Shafts, Crank
Standard Connecting Rod Co., Beaver Falls, Pa.

Shapers
American Tool Wks. Co., Cin. O.
Barker & Co., Wm., Cincinnati, O.
Bement, Miles & Co., New York.
Cincinnati Shaper Co., Cincin., O.
Flather Planer Co., Mark, Nashua, N. H.
Garvin Mach. Co., New York.
Hendey Mch. Co., Torrington, Ct.
Gould & Eberhardt, Newark, N. J.
Hill, Clarke & Co., Boston, Mass.
Kelly Co., R. A., Xenia, Ohio.
Marshall & Huschart Mchry. Co., Chicago, Ill.
Morton Mfg. Co., Muskegon Heights, Mich.
New Haven Mfg. Co., New Haven, Conn.
Niles Tool Works Co., New York.
Perkins Mach. Co., Boston, Mass.
Potter & Johnston Mach. Co., Pawtucket, R. I.
Smith & Mills, Cincinnati, O.
Steptoe & Co., John, Cincinnati, O.

Shears, Power
Bethlehem Fdry. & Mch. Co., So. Bethlehem, Pa.
Bliss Co., E. W., Brooklyn, N. Y.
Bremer Mach. & Tool Co., Kalamazoo, Mich.
Buffalo Forge Co., Buffalo, N. Y.
Cleveland Punch & Shear Works, Cleveland, O.
Hilles & Jones Co., Wilmington, Del.
Long & Allstatter Co., Hamilton, Ohio.
National Mchry. Co., Tiffin, O.
Perkins Mach. Co., Boston, Mass.
Pittsburg Shear Knife & Mach. Co., Pittsburg, Pa.
Reade Mchry Co., Cleveland, O.

Shears, Rotary
Bethlehem Foundry & Mach. Co., So. Bethlehem, Pa.
Detrick & Harvey Mach. Co., Baltimore, Md.
Perkins Mach. Co., So. Boston, Mass.

Shelving, Shop
New Britain Mach. Co., New Britain, Conn.

Slide Rests
Bartlett, E. E., Boston, Mass.
Reed Co., F. E., Worcester, Mass.

Slotters
Baker Bros., Toledo, Ohio.
Bement, Miles & Co., New York.
Betts Mach. Wks., Wilmington, Del.
Dill Mach. Co., T. C., Phila., Pa.
Franklin Mach. Wks., Phila., Pa.
Garvin Mach. Co., New York.
New Haven Mfg. Co., New Haven, Conn.
Newton Mach. Tool Wks., Philadelphia, Pa.
Niles Tool Works Co., New York.

Spike Machines
National Machy. Co., Tiffin, O.

Sprocket Chains
See Driving Chains.

Stampings, Sheet Steel
Federal Mfg. Co., Cleveland, O.

Stamps, Steel
The Chandler Co., Springfield, Mass.
Schwerdtle Stamp Co., Bridgeport, Conn.

Steel, Machinery
Boker & Co., Hermann, New York.
Patriarche & Bell, New York.
Ward & Son, Edgar T., Boston, Mass.

Steel, Sheet
Federal Mfg. Co., Cleveland, O.
Ward & Son, Edgar T., Boston, Mass.

Steel, Tool
Boker & Co., Hermann, New York.
Patriarche & Bell, New York.
Westmoreland Steel Co., Pittsburg, Pa.

Straightener, Hydraulic
Bement, Miles & Co., New York.
Watson-Stillman Co., New York.

Swaging Machines
Excelsior Needle Co., Torrington, Conn.
Iroquois Mach. Co., Provi., R. I.
Mossberg & Granville Mfg. Co., Providence, R. I.

Switchboards
C & C Electric Co., New York.
Electric Controller & Supply Co., Cleveland, O.
Triumph Elec. Co., Cincinnati, O.
Western Electric Co., Chicago, Ill.

Tapping Machines and Attachments
Baker Bros., Toledo, O.
The Beaman & Smith Co., Providence, R. I.
Bickford Drill & Tool Co., Cin., O.
Cincinnati Mach. Tool Co., Cincinnati, O.
Errington, F. A., N. Y. City.
Fosdick Mach. Tool Co., Cin., O.
Garvin Mach. Co., New York.
Geometric Drill Co., New Haven, Conn.
National Mchry. Co., Tiffin, O.
Pratt & Whitney Co., Hartford, Conn.
Seneca Falls Mfg. Co., Seneca Falls, N. Y.
Webster & Perks Tool Co., Springfield, O.

Taps, Collapsing
Geometric Drill Co., New Haven, Conn.

Taps and Dies
Besly & Co., Chas. H., Chicago, Ill.
Card Mfg. Co., S. W., Mansfield, Mass.
Carpenter Tap & Die Co., J. M., Pawtucket, R. I.
Cleveland Twist Drill Co., Cleveland, O.
Crane Co., Chicago, Ill.
Hammacher, Schlemmer & Co., New York.
Hardinge Bros., Chicago, Ill.
Hart Mfg. Co., Cleveland, O.
Morse Twist Drill & Mach. Co., New Bedford, Mass.
National Mchry. Co., Tiffin, O.
Pratt & Whitney Co., Hartford, Conn.
Standard Tool Co., Cleveland, O.
Webster & Perks Tool Co., Springfield, O.
Wells Bros. Co., Greenfield, Mass.
Wiley & Russell Mfg. Co., Greenfield, Mass.
Winter Bros. Co., Wrentham, Mass.

Telephone System
Clarke Auto. Telephone Switch Board Co., Providence, R. I.

Thread Cutting Tools
Besly & Co., Chas. H., Chicago, Ill.
Hart Mfg. Co., Cleveland, O.
Pratt & Whitney Co., Hartford, Conn.
Rivett-Dock Co., Boston, Mass.

Tool Holders
Armstrong Bros. Tool Co., Chicago, Ill.
Hill Tool Co., Anderson, Ind.
Hoggson & Pettis Mfg. Co., New Haven, Conn.
McCrosky & Huber, Cincinnati, O.

Tools
See Machinists' Small Tools.

Transmission Machinery
American Pulley Co., Phila., Pa.
Caldwell & Son Co., H. W., Chicago, Ill.
Cresson & Co., Geo. V., Phila., Pa.
Link-Belt Engineering Co., Philadelphia, Pa.
Patterson, Gottfried & Hunter, Ltd., New York.
Reeves Pulley Co., Columbus, Ind.

Traps, Steam
Houghton & Co., E. F., Philadelphia, Pa.

Trimmers, Wood
Amer. Mchry. Co., Grand Rapids, Mich.
Washburn Shops, Worcester, Mass.

Trolleys and Tramways
Brown Hoisting Machy. Co., N. Y. City.
Harrington, Son & Co., Edwin, Philadelphia, Pa.
Hunt Co., C. W., West New Brighton, N. Y.
Link Belt Engineering Co., Philadelphia, Pa.
Maris Bros., Philadelphia, Pa.
Yale & Towne Mfg. Co., New York.

Tube Cutter, Glass
Gifford & Morrow, Tyrone, Pa.

Turrets, Carriage
Bayldon Mach. & Tool Co., Jersey City, N. J.
Fay & Scott, Dexter, Me.

Turret Machines
Automatic Mach. Co., Greenfield, Mass.
Bradford Mach. Tool Co., Cincinnati, O.
Brown & Sharpe Mfg. Co., Providence, R. I.
Bullard Mach. Tool Co., Bridgeport, Conn.
Dreses Mach. Tool Co., Cincin., O.
Flather & Co., Nashua, N. H.
Garvin Mach. Co., New York.
Gisholt Mch. Co., Madison, Wis.
Hill, Clarke & Co., Boston, Mass.
Jones & Lamson Mch. Co., Springfield, Vt.
Le Blond Mach. Tool Co., R. K., Cincinnati, O.
Lodge & Shipley Mach. Tool Co., Cincinnati, O.
Niles Tool Works Co., New York.
Pearson Mach. Co., Chicago, Ill.
Potter & Johnston Mach. Co., Pawtucket, R. I.
Warner & Swasey Co., Cleveland, Ohio.
Windsor Mach. Co., Windsor, Vt.

Twist Drills
Cleveland Twist Drill Co., Cleveland, O.
Etna Mfg. Co., New York.
Hammacher, Schlemmer & Co., New York.
Morse Twist Drill & M. Co., New Bedford, Mass.
Standard Tool Co., Cleveland, O.

Unions, Brass
Nolte Brass Co., Springfield, O.

Universal Joints
Baush Machine Tool Co., Springfield, Mass.
Vanderbeek Tool Works, Hartford, Conn.

Valves
See Steam Fittings.

Vises, Drill
Graham Mfg. Co., Provi., R. I.
Hollands Mfg. Co., Erie, Pa.
Jacobson Mach. Mfg. Co., Warren, Pa.

Vises, Metal Workers'
Hammacher, Schlemmer & Co., New York.
Jacobson Mach. Mfg. Co., Warren, Pa.
Parker Co., Chas., Meriden, Conn.
Vanderbeek Tool Works, Hartford, Conn.
Walworth Mfg. Co., Boston, Mass.

Vises, Pipe
Curtis & Curtis Co., Bridgeport, Conn.
Saunders' Sons, D., Yonkers, N. Y.
Walworth Mfg. Co., Boston, Mass.

Vises, Planer and Shaper
Cincinnati Planer Co., Cincin., O.
Hendey Mach. Co., Torrington, Ct.
Pratt & Whitney Co., Hartford, Conn.

Vises, Wood Workers'
Hammacher, Schlemmer & Co., New York.
Wyman & Gordon, Worcester, Mass.

Washer Machines
National Machy. Co., Tiffin, O.

Welding Machines
Long & Allstatter Co., Hamilton, Ohio.

Wire-Drawing Machinery
Iroquois Mach. Co., Provi., R. I.
Mossberg & Granville Mfg. Co., Providence, R. I.

Wire-Forming Machinery
Automatic Mach. Co., Bridgeport, Conn.

Wood Working Machinery
American Machinery Co., Grand Rapids, Mich.

Worm Hobbing Machines
Pratt & Whitney Co., Hartford, Conn.

Worm Milling Machines
Cleveland Automatic Mach. Co., Cleveland, O.
Pratt & Whitney Co., Hartford, Conn.

Wrenches
Coes Wrench Co., Worcester, Mass.

Wrenches, Drop Forged
Billings & Spencer Co., Hartford, Conn.

A New Surface Grinder.

Our readers are familiar with the advantages of the surface grinder in handling many classes of work, and we believe they will be interested in a grinder, herewith illustrated, which has recently been put on the market by the Safety Emery Wheel Company, of Springfield, Ohio.

The machine is open in front, and work of considerable size may be readily machined with it. The bed of the machine is a heavy casting provided with ways at the rear for a square column or upright—to which is fitted the head for the wheel spindle, and having bolted fast at the front a casting provided with ways for the carriage or work table. The bed is closed at the bottom, near the center, to form a tank, and soda water for use on the wheel is supplied from here by the centrifugal pump shown in Fig. 2, the table being so constructed that all liquid is caught after using and returned to the tank.

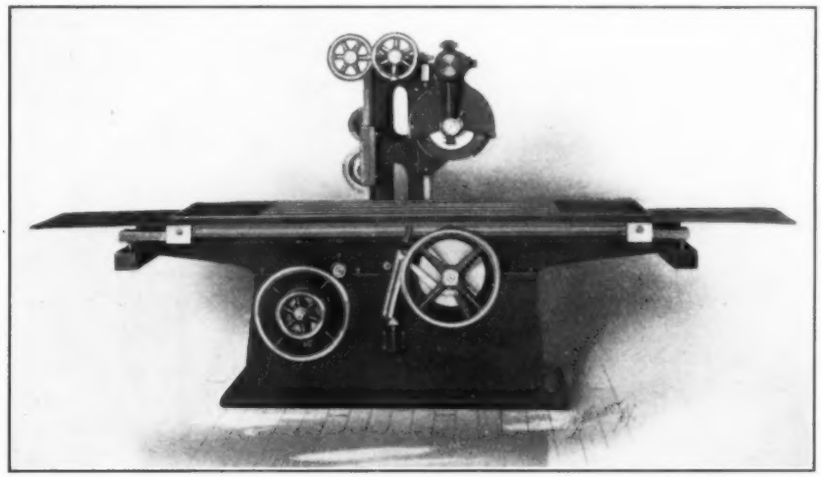


FIG. 1. NEW SURFACE GRINDER.

The table has a planed surface 50 inches long by 14 inches wide, and is provided with either three or five T-slots for ½-inch bolts. It is triple geared, and driven from the pulleys shown at the side in Fig. 2. The stroke of the table is varied by shifting the dogs clamped in front. The table may be instantly stopped at any point in its travel by loosening the small hand wheel, shown in front in Fig. 1, thus releasing the friction clutch inside. The table is traversed by hand by means of the large hand wheel, which is mounted at the back of the small wheel. Pockets formed at the ends of the table, and guards fitted as shown, prevent water or dust from striking the ways.

The upright carrying the head and wheel is moved on its ways, to give the feed to the wheel, by a screw which is operated automatically through a ratchet wheel and pawl at the front of the bed. Hand feed for the wheel is by means of the hand-wheel shown in front of the ratchet wheel. The automatic feed in either direction may be varied from 0 to ⅛ inch per stroke of table. The plate upon which the head is mounted is square gibbed to the upright and may be clamped fast at any desired point. By loosening nuts *a*, *b*, *c*, Fig. 3, the head, with its wheel spindle and overhanging arm, may be swiveled on the plate and set at such an angle that the side of the wheel will clear when facing down the side of a job. The head is elevated by a screw operated through worm wheel and worm from a hand wheel which is shown, in Fig. 1, at the top of the machine. The hand wheel shown to the left, at the top, operates a screw for elevating or lowering a slide that carries two idlers by means of which the driving belt for the wheel spindle is always kept under proper tension.

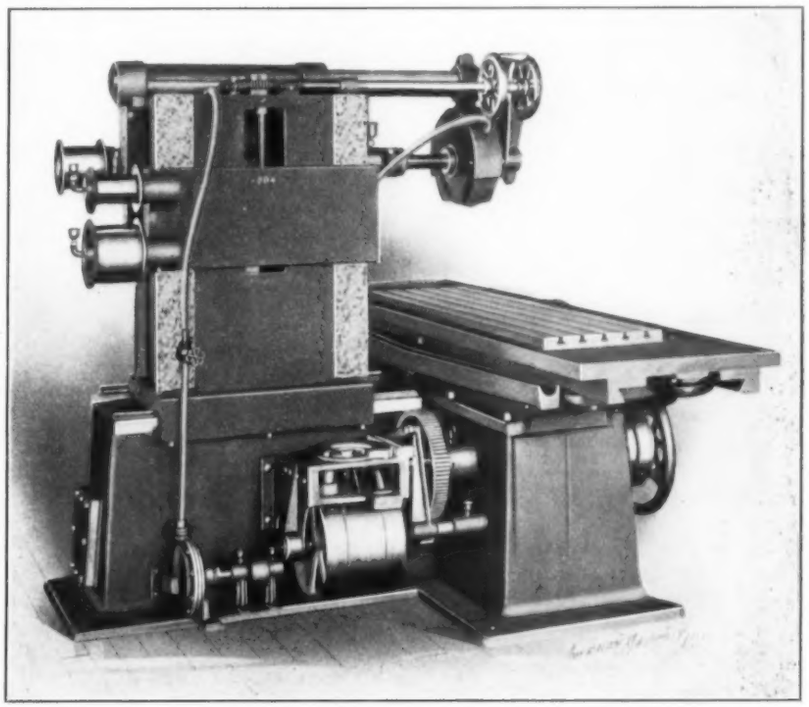


FIG. 2. SURFACE GRINDER—SIDE VIEW.

The arbor for the wheel is 2½ inches in diameter at the bearings and 1½ inches in diameter at the wheel end. It runs in tapered bearings which are so constructed that all lost motion may be taken up. These bearings are quite long, the one in front being 17 inches and the one in the rear 9 inches in length. The bearing at the outer end is 2 inches long. The driving pulley on the arbor is 5 inches in diameter by 4 inches face, and the wheel used is 12 inches in diameter by 1½ inches thick.

The machine takes in work 50 inches long, 16 inches wide and 12 inches high, and weighs with countershaft 5,000 pounds.

The Action of Cutting Tools.*

I am not aware if any acceptable definition of the term "cutting action" has ever been made.

We understand clearly what is meant by shearing, and recognize that this plays some part in what we commonly call "cutting." For example, in the use of parting tools we know that the metal is shorn from the sides of the cut, the surfaces there being left correspondingly rough. But where the chip is removed by the end of the tool, the surfaces are left smooth, and we recognize here an action which we distinguish from shearing by calling it "cutting action."

Mr. Mallock and Profesor Smith have shown, however, that this which we call more particularly "cutting action" may be itself largely composed of shearing. They show that in turning mild steel, for example, the tool acts by compressing the material in front of it until rupture occurs by shearing within the body of the chip, and

*From a paper read before the British Association by William Taylor.

that by such intermittent action chips are sometimes removed. But this is not always so. If instead of steel we take for illustration an extremely plastic substance, such as butter, or even lead, or a substance which is both elastic and plastic, such as moderately dry cheese, we can remove chips apparently without such shearing action, because the chips are sufficiently elastic or plastic to bend or flow without rupture, and permit the passage of the tool. Again, in planing wood along its grain, the chips are not removed by intermittent shearing, but if ruptured at all are ruptured by bending.

But these various accompaniments of cutting action are not the real essence of the thing. What we recognize especially as the thing itself is the more or less perfect action of a tool edge in reaching into the material, as a boat cuts the water, to decide the plane of separation of the chip. When this ceases, when from any

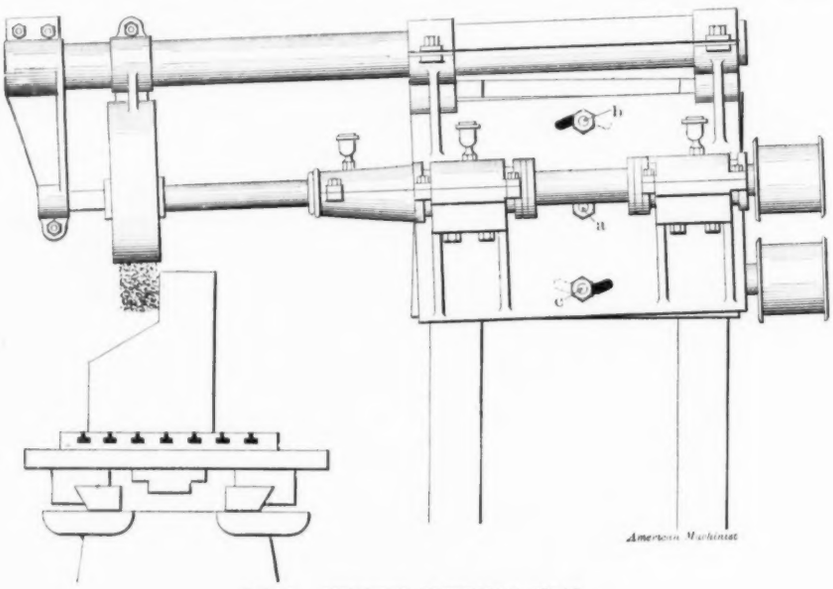


FIG. 3. SHOWING SWIVELING HEAD.

cause rupture occurs in advance of the cutting edge and within the body of the material, then perfect cutting action ceases; but rupture of the chip, whether it be caused by bending or shearing, and although in some cases it may be necessary to permit continued motion of the tool, is not the essential part of cutting action.

A more complete knowledge of the factors concerned would enable us to find a satisfactory answer to the question which has been discussed among engineers, as to the respective merits of high speeds and fine feeds, and of low speeds and thick chips; and the whole question of the best forms of cutting tools for various purposes and material might be put upon a connected and intelligible basis.

In materials such as glass, stone and hardened steel, which have no appreciable plasticity, and which suffer only slight elastic deformation, what I have attempted to define as true cutting action cannot take place. Instead of it, we have an action composed almost entirely of that intermittent shearing which has been described, and as the result we get with such materials only ragged and broken surfaces which require further treatment to render them smooth. Moreover, for such materials, hardened steel tools are not hard enough, nor can the removal of large chips be controlled with sufficient accuracy. It is therefore necessary to take small chips, and to use harder tools in the form of abrasive materials. Abrasives in the form of natural stones, also as emery, diamond dust and other hard particles supported in metal laps, have been used for centuries; but their action appears to have been studied but little scientifically. Their use is, however, extending rapidly, both in the form of wheels and of rings, in which the abrasives are held by vitreous bonds, and as the more tenacious abrasive-coated steel disk, which withstands velocities of 10,000 to 15,000 feet per minute. Among the exceedingly able makers of these abrasive wheels, very little appears to be definitely known as to the way in which the various factors enter into their efficiency. It is known in general terms that a hard wheel —that is, one containing a large proportion of the vitreous bond—must be run more slowly than a softer wheel; also that with wheels having the same proportion of bond, one having its abrasive in finer particles behaves as a harder wheel; but it is not definitely known in what ways the coarseness of the abrasive, the strength of the bond, and the velocity of action should be related to the structure and mechanical properties of the material to be ground and to the purpose in view.

In operating on the surfaces of metals and other plastic substances, the action of an abrasive appears to consist partly in shearing off minute particles, and partly in causing the metal to flow into the cavities, as it is made to flow under a burnisher, or as plaster is laid smooth under the mason's trowel. With glass and hardened steel, which possess but little of this plastic property, the action is chiefly confined to the first mode, and has been described by Lord Rayleigh in connection with the optical polishing of glass.

At high velocities, however, it appears likely that abrasives act on all metals and fusible substances largely by heating the particles which they remove, and so, for the instant, by increasing their plasticity, permitting true cutting and burnishing actions. That particles are so softened before being removed is, of course, proved by their coming off as a shower of sparks.

In the case of metal laps charged with abrasives for grinding hard materials, it is known in general terms that the lap must be softer than the material to be ground, as lead lap for cast iron, a cast-iron lap for hardened steel, a soft steel lap for diamonds; it is generally known that the hardness of a lap must vary with the size of the abrasive particles; thus soft laps are used for polishing steel, and laps of wax or pitch for polishing glass lenses; but precisely what is the best relation of these things, as measured by the structure and mechanical properties of the material, does not appear to be known.

Recent experiments in sawing glass with diamond-charged steel disks appear to show that the greatest efficiency is reached at a certain velocity. This suggests that the time element, which has been illustrated by the behavior of pitch, may have some influence in abrasive action at high velocities.

A Diagram for Photographic Exposures.

BY F. W. SEIDENSTICKER.

Herewith I send you a diagram for finding the time necessary to expose photographic plates. There have been a great many diagrams published in the AMERICAN MACHINIST during the last few years, all on mechanical subjects, but as nearly every drawing office and machine shop has a camera, I think that this one belongs in the same class. It has been plotted from a set of tables which gave excellent results and they were put into the form of a diagram as being more easily handled. The tables were calculated for average conditions for the latitude of Chicago, but the difference in latitude of the different sections of the United States will not affect the accuracy to amount to anything. For a very rapid lens the exposure given by the diagram will have to be reduced somewhat, while for a slow lens it will have to be increased.

The diagram will be seen to consist of six sets of lines, one for each factor entering into the problem. The first set is for the time of the year, each line indicating the middle of the month. The position at any other time can be readily estimated; for instance, September 1 is half way be-

tween the lines marked August and September. The second set is a lot of curves for the time of the day. At the upper end of each curve are two numbers, the first being for the time in the forenoon and the other for that in the afternoon. to take a picture before 8 in the morning or after 4 in the afternoon. The third set is for the different kinds of light, and needs no explanation. The next set is for the speed of the plate and is plotted for the Seed plates. The relative speeds of

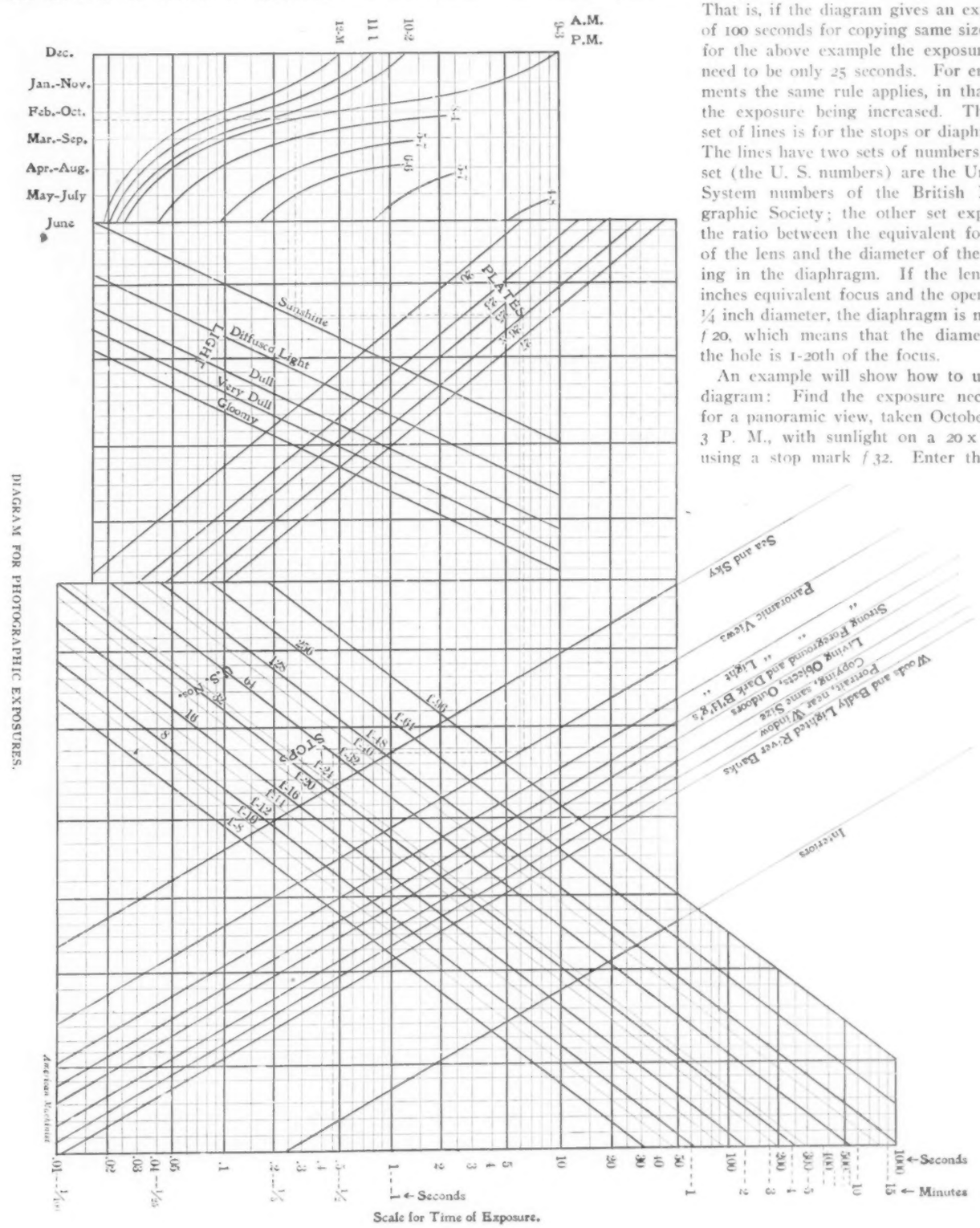


DIAGRAM FOR PHOTOGRAPHIC EXPOSURES.

only one line, that for a copy of the same size as the original is given. If the copy is only half as great in linear measure as the original, or is one-quarter as large in area, the exposure necessary will only be one-quarter of that given by the diagram. That is, if the diagram gives an exposure of 100 seconds for copying same size, then for the above example the exposure will need to be only 25 seconds. For enlargements the same rule applies, in that case the exposure being increased. The last set of lines is for the stops or diaphragms. The lines have two sets of numbers. One set (the U. S. numbers) are the Uniform System numbers of the British Photographic Society; the other set expresses the ratio between the equivalent focus of of the lens and the diameter of the opening in the diaphragm. If the lens is 5 inches equivalent focus and the opening is ¼ inch diameter, the diaphragm is marked *f* 20, which means that the diameter of the hole is 1-20th of the focus.

An example will show how to use the diagram: Find the exposure necessary for a panoramic view, taken October 8 at 3 P. M., with sunlight on a 20 x plate, using a stop mark *f* 32. Enter the diagram at the first set of lines and following the dotted line on the diagram to the other sets in the order in which they are given in the explanatory matter, the exposure is found to be .46 second, or prac-

When the line for the month does not cross a curve it indicates hat it is not possible to get a negative, in the limits given by the diagram. For example, after the middle of October it is not feasible other makes can be ascertained from the dealer. The fifth set is for the different subjects, and it is here that a person has to use his judgment. Experience only will tell just what line to use. For copying

tically ½ second. Most shutters can be set so as to give different lengths of exposures automatically, usually 1-100, 1-25, ⅛, ½ and 1 second, and by changing the

FIG. 1. HORIZONTAL TWO-SLIDE PRESS FOR PUNCHING HOLES IN OPPOSITE SIDES OF DRAWN SHELLS.

size of stop it will be possible to regulate the length of exposure required so that one of these speeds can be used.

Perforating Flat and Cylindrical Sheet Metal.

BY JOSEPH V. WOODWORTH.

In the production of plates and articles with numerous perforations, dies accompanied by novel mechanical devices play a more important part than in any other line of sheet metal work. While the dies used for such work are comparatively simple, the devices and appliances used in connec-

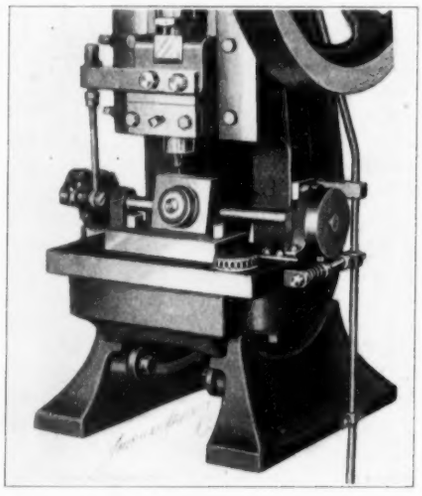


FIG. 2. DIES AND FIXTURE FOR PERFORATING BURNER SHELL.

tion with them are often intricate and novel. Especially is this so in the perforation of cylindrical articles and parts, where the die remains stationary and the shell is rotated sucessively at each stroke of the press, until the entire surface has been worked upon. By means of these rotating devices shells may be perforated in any design or pattern of perforations by means of a single row of dies, the manner in which the shell is rotated after each stroke determining the pattern of the perforations. Anyone who has noticed the odd, novel and artistic designs in the perforated shells used on gas and lamp burners and fixtures must have wondered how they can be produced so cheap. The secret lies principally in the devices used for rotating, and further on we show a number of such devices and the dies and tools used with them.

In the perforating of flat sheets of metal the construction of the dies used is usually similar to that followed out in the "gang" types, and they are used on work ranging from ornamental sheet metal articles to the punching of holes in steel beams and boiler plates. The holes pierced with dies of this type may be of any shape desired and may be spaced in any manner or combination. Often the usual conditions are reversed and instead of the perforations being desired, small blanks are the objects sought, a number of them being produced at each stroke of the press, sheets of the required width being fed to the dies automatically. Perforated sheets of the different metals are now in great demand and are used for a variety of purposes too numerous to mention.

In Fig. 1 is shown a horizontal two-slide foot press for punching simultaneously two holes or slots on opposite sides of drawn shells. The die is located in the center and is made with cutting edges on opposite sides and with a clearance hole through the bottom as an escape for the scrap or punchings. The punches are of steel rod fastened in punch-holders or chucks which are adjustable and mounted on slides provided with adjustable gibs. Each slide is arranged with an adjustable stop to allow of piercing shells of different diameters. Dies of this type, when used in a machine of the type shown, are very convenient for rapidly and accurately producing pierced shells for lamp-burners, satchel locks and a variety of other pierced work requiring holes pierced on opposite sides.

Figs. 2 to 6 show five different sets of perforating fixtures in position on presses for perforating burner shells and other cylindrical sheet-metal articles. Fixtures of these types are used extensively for work which it is desired to perforate all around, although sometimes used to perforate in sections only.

The attachment shown on the press in Fig. 2 is used for taper and crowning shells, which necessitates the setting of the die-holder and rotating device at an angle with the lower face of the slide. The shell as perforated is shown on the press bolster at the right.

Fig. 3 shows a press equipped with dies and fixt res for perforating small close patterns in bottomless shells. As will be seen from the half-tone, in which a die, punch and two perforated shells are shown on the floor, the die is a piece of steel with two rows of holes in it and dovetailed into the work-holder, while the punch is equipped with a spring stripper and two rows of piercing punches. The dies shown located in the press are for perforating the s all shell, and the ones on the floor for perforating the large one shown at the right at the bottom.

In the attachments of the types shown in Figs. 2 and 3 the perforating dial with a chuck of suitable shape is mounted on a die-holder, and a ratchet having teeth spaced to suit the holes or pattern desired

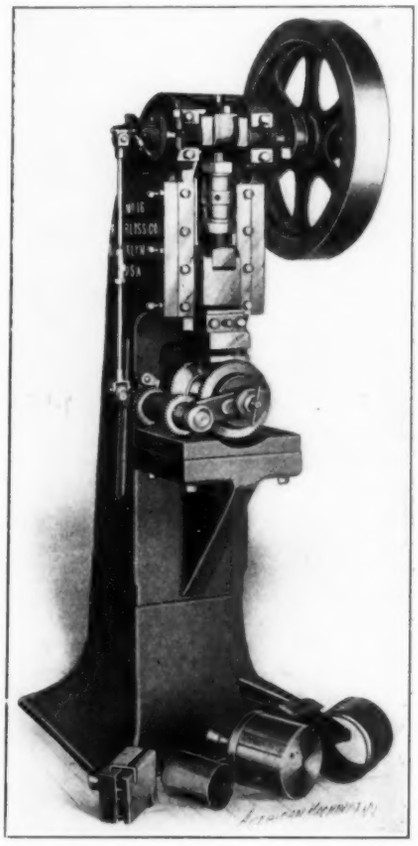


FIG. 3. DIES AND FIXTURES USED IN PERFORATING SMALL CLOSE PATTERNS IN BOTTOMLESS SHELLS.

is mounted and arranged to rotate the shell at each stroke of the press. By the use of such attachments perforating may be done at the rate of 150 to 200 strokes per minute.

The adjustment of the parts of these perforating attachments is easily and quickly made, so that but a short time is required to change the attachments from one style of shell to another. Presses in which such attachments are used are often provided with a latch lock for the clutch connection, which is automatically released after each complete rotation of the article on the perforating chuck, thus stopping the press automatically after the requisite number of strokes have been made.

In Fig. 4 is shown a set of dies as located in an inclinable press for accurately piercing and blanking armature disks for small generators and motors. The press is furnished with an automatic

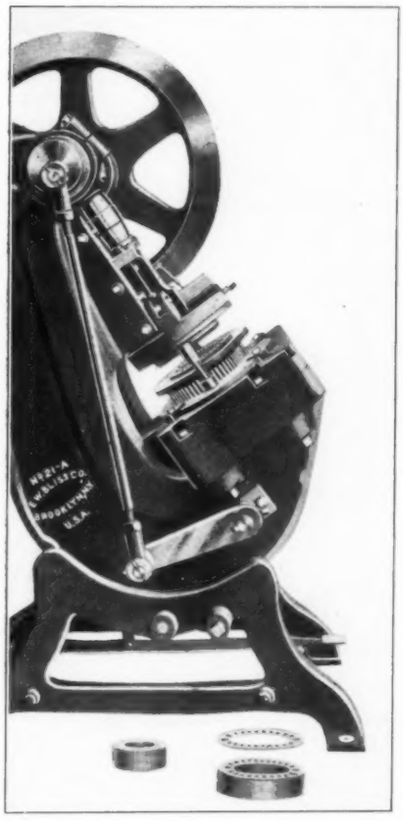


FIG. 4. PRESS WITH DIES FOR PUNCHING OUTSIDE AND INSIDE AND PIERCING EDGE SLITS IN SMALL ARMATURE DISKS.

knock-out, and its inclined position allows the blank, after being punched and pierced, to be lifted out of the die and slide off at the back. The pierced blanks are usually punched from strips sheared to the necessary width. The construction of the dies is such as to allow the outside and the inside to be punched simultaneously, after which it is held between the faces of the blanking punch and the pad, and descends far enough for the piercing punches located around the die to pierce the holes. The finished disks are shown beneath the press.

For perforating articles of considerable size, or flat plates which are required to be kept straight, dies of the usual construction will not do good work, as on such dies stationary strippers are used and they are liable to distort the metal to such an extent as to require subsequent straightening. To overcome this defect a press equipped with a cam-actuated stripper should be used, especially on accurate work, such as parts of clocks, electrical instruments, etc. A press equipped in this manner is shown in Fig. 5. The stripping device is such as to leave a clear space between the punch and die, thus allowing the operator to manipulate and observe the work at will. The action of the stripper when the press is running is as follows: The stripper plate strikes the blank or article first, straightening and clamping it before the punches enter, and holding it under pressure while the punching and stripping are being accomplished. In this manner a flat or formed piece comes out perfectly straight and true. The punches used when a press is equipped with a stripper of this type may be made considerably shorter than where a die with a stationary stripper is used, thus making them more durable. Also by this arrangement a smaller hole in proportion to the thickness of the stock may be punched, because of the support given to the punches by the movable stripper up to the point where they enter the stock.

For the perforating of large sheets of metal in designs similar to those shown in Fig. 6, special feeding arrangements are used. Some of the patterns are staggered and others are regular, and to produce them a single row or gang of punches and dies on a double row is used. When a double row or gang of punches and dies is used, the metal is usually fed automatically by means of a roller feed to a press of large and powerful construction. The construction of the punches and dies for such work is such as to allow of removing any one or a number without disturbing the others. The punches are usually located in a cast-iron holder which is fitted to a dovetailed channel in the face of the press ram. They are short and stocky and fastened by set-screws. The dies are usually tool-steel bushings, hardened and ground, and let into holes drilled and reamed in a bolster of similar make to that used for the punches. The bushings also are fastened by set-screws. With a powerful press equipped with proper feeds and punches and dies the writer has seen one hundred and fifty-four $\frac{3}{8}$-inch holes punched in $\frac{1}{4}$-inch plate at each stroke of the press. The press referred to was used in the works of a large agricultural machinery concern and was provided with a roller feeding attachment consisting of four adjustable rolls, 6 inches in diameter and 54 inches long, which fed the stock automatically in multiples of sixteenths of an inch up to four inches. For heavy work the press was provided with back gears which were thrown out when doing light work so as to give the press a higher speed. The slide adjustment on this press was such as to allow of raising or lowering it to overcome the shortening of the punches through wear.

One of the largest producers of perforated metal in the world is the Allis-

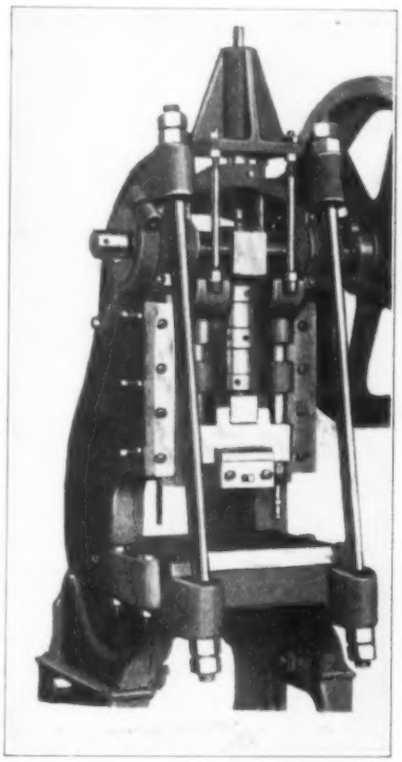


FIG. 5. PRESS WITH CAM-ACTUATED STRIPPER FOR STRAINERS, PARTS OF CLOCKS, ETC.

Chalmers Company, of Chicago. In their shops improved machinery is being constantly provided for the production of perforated metal in the endless varieties which modern demands necessitate. The chief aim in this plant is to produce the material at the lowest cost and in the shortest time possible. This object, of course, can only be attained by keeping the machines constantly producing perforated sheets of the same design and pattern. Most of the output in this line produced in the above-mentioned shops is used for rotating screens for stone, grain, coal, ore, etc., the perforated plates being rolled to exact diameters in special machines. For such purposes perforated metals have superseded and are far supe-

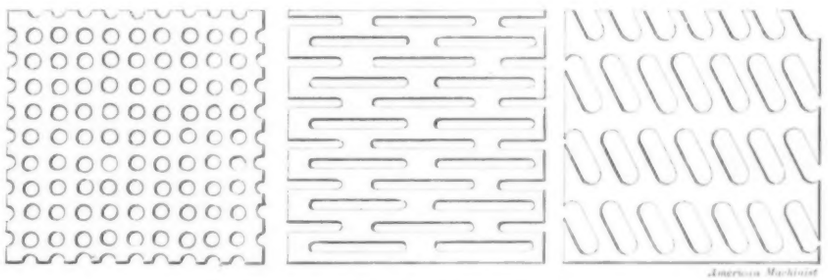


FIG. 6. SAMPLE DESIGNS OF PERFORATED SHEET METAL.

rior to wire cloth, being much stronger, more uniform in size of hole and mesh, less liable to tear or rust out, and in case of breakage they may be easily repaired or replaced without affecting the entire sheet. In screens for various purposes it is often desirable to arrange them with portions left blank. This can be easily done when perforated metal is used, as the sheets can be perforated in a press equipped with a feed which can be adjusted to feed unequal spacings.

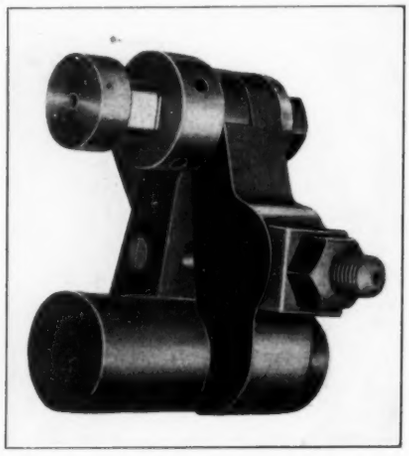


FIG. 1. A NEW LATHE DOG.

A New Lathe Dog.

The accompanying illustrations show a new lathe dog, the outline sketch showing the details. *A* is a stud slipped into the slot in face-plate, and securely fastened to it by round nut *B*. Stud *A* is prolonged to carry jaws *C* and *D*, which are slipped on the stud and held by nut *E*. Spring *F* is fastened between the jaws so as to throw them open when the bolt *G* is released. *G* is fastened in a slot in jaw *D* by a close-fitting pin as shown, passes through an elongated hole in jaw *C*, and is fitted with a nut *I*.

In operation, the stud *A* is slipped into a slot in the lathe face-plate, the centers of the jaws being brought in line with the lathe center, and the nut is then tightened. The piece to be turned is then hung on the lathe center, the jaws *C* and *D* hanging open. Nut *I* is then tightened and a turn is taken in nut *E*, when the dog is locked to both face-plate and piece. In releasing, nut *I* is slackened and the spring *F* throws the jaws open following the nut.

This dog is made by the Eddystone Engineering Works, of Eddystone, Pa., in four sizes to take in stock from 1 to 12 inches diameter.

Notes on Crane Design.

BY A. D. WILLIAMS.

The electrical equipment of cranes contains numerous small details, all of which call for careful consideration. The "juice" is necessary to operate the machine and any failure in this line puts the crane out of business temporarily. All parts of this equipment should be so arranged and constructed that disabled parts can be replaced as easily as possible. Spare parts should be carried in stock for all pieces liable to give trouble or wear out in reasonable use. When breakdowns occur any delay in repairing is excessively expensive. It is peculiar that a supply of spares seems to assist in preventing breaks, though perhaps this is due to the fact that where such reserves are carried the machines are usually better looked after, repairs being made before and not after a breakdown.

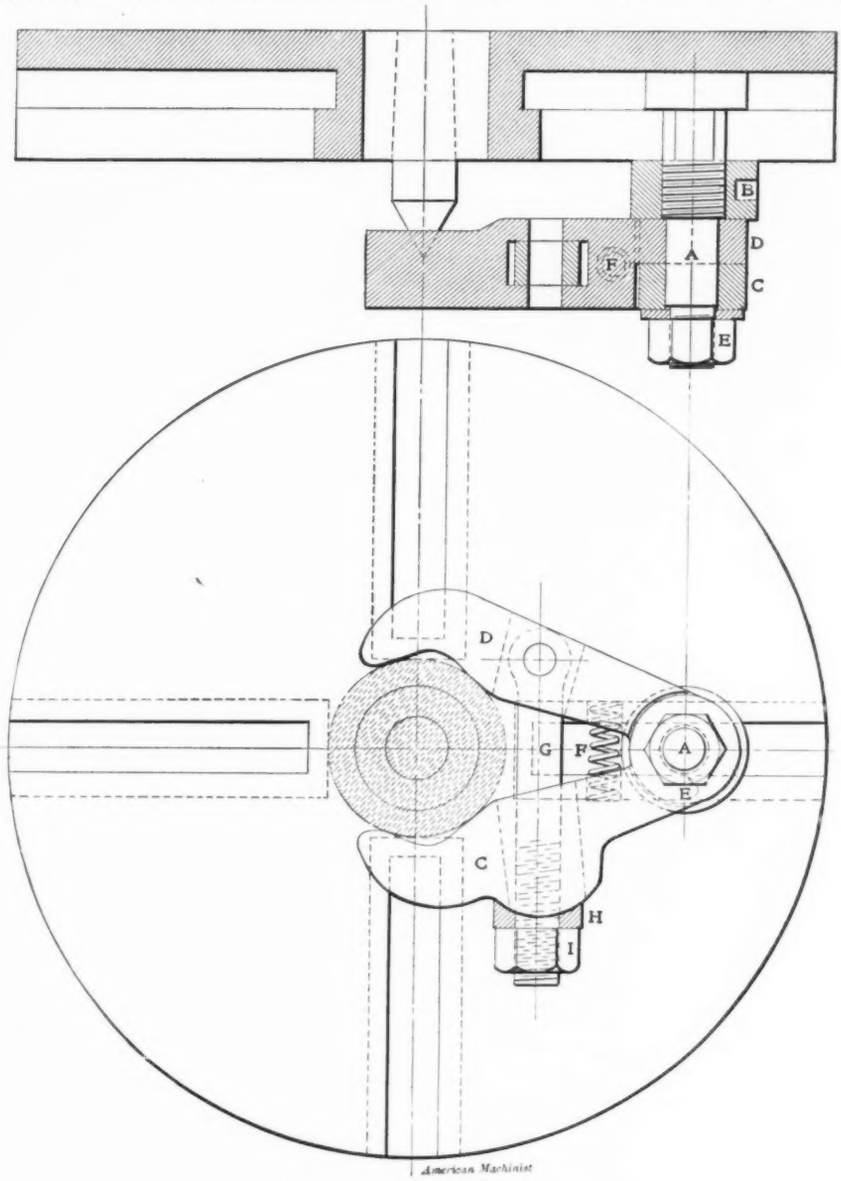


FIG. 2. A NEW LATHE DOG.

The crane switchboard should be located at some convenient place in the operator's cage. The main switch should be a double pole, double break, knife switch mounted on a fireproof base. This switch must be so mounted that it cannot close itself, and should only be closed when the crane is in use. Rigid adherence to this rule will be found advisable. The switchboard should also contain pilot lamps to show whether the current is on or off, and a ground detector lamp. Each individual circuit should be protected by a fuse or automatic circuit breaker. The latter is the most convenient, but also more expensive. Fuses must be mounted on a fireproof base. With fuses there is a constant temptation to put in too large a wire that may sometimes result in burning out the motor before the fuse blows. Fusible wire of the proper size is readily obtained, also the necessary copper tips; but in practice it is generally found more convenient to use small sizes of copper wire for this purpose This is not liable to cause trouble, if care is used to select the proper wire. With the circuit breaker there is no chance to make a mistake in its carrying capacity.

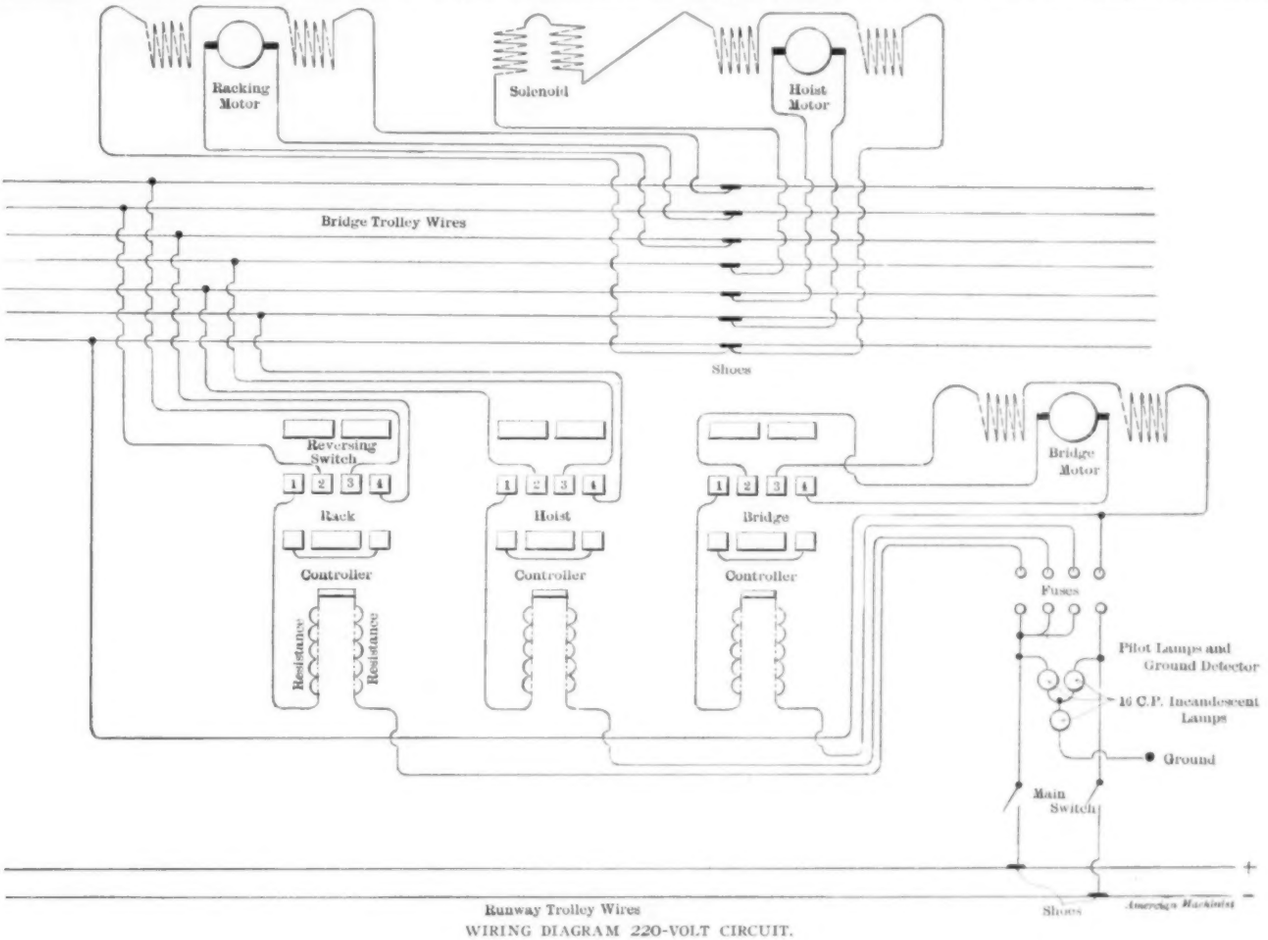
The size of wire required for the various circuits can be found by methods thoroughly explained in the "Pocket Books." Stranded conductors are more convenient for the larger sizes. There are a great many different qualities of insulated wire. A great deal of so-called "weatherproof

wire" is used, but it is not suitable for damp places. From the crane user's standpoint a good quality of rubber insulation is desirable. The wiring should be run so that all connections can be broken and remade without solder. Wire ends of copper or brass soldered to the wires, and fitting the various binding posts or connectors should be used. As far as possible, the wires should be run in molding, conduit, or on porcelain insulators, and kept clear of each other. The various trolley wires should be drawn tight, and some means of adjustment provided to take up any slack. They should be far enough apart to avoid their sagging together. A closer vertical spacing than 3 inches is desirable, and a wider spacing is better. Where these wires run close to a girder, wooden battens should be used to prevent their swinging against it. Especial care should be taken in insulating the trolley wire anchors, in which place some hints from street railway practice can be utilized. Along the runways the trolley wires require intermediate supports, which can be supplied by the use of insulating brackets, upon which the wire lies, bolted to the girders. These brackets must be placed low enough to clear the collector shoe. On long runways, to avoid very heavy wires, it is sometimes necessary to feed the trolley wire at some intermediate point. This can be done by using feeder ears.

The collector shoes should be arranged so that a shoe can be renewed easily without disturbing its neighbors. For light wires a brass shoe underrunning the wire is satisfactory. Graphite facings can be employed to reduce the friction. For heavy wires small brass wheels can be used to advantage. When dealing with large currents it is usually better to employ several small wires in place of one large one.

The entire manipulation of the crane depends upon the controller. Ease of operation and certainty of control must be obtained. No material that can be inflamed or carbonized should be employed for insulating purposes. All contact surfaces should be renewable, and carbon brushes should be used. Compactness is desirable, as the space available is limited. Lever operation is best, the lever standing vertical when the current is cut off and its direction of motion corresponding to the motion of the machine. The centering device to lock the lever when vertical should be sure in action, yet it must not offer too great a resistance to motion. An unintentional reversal may be serious, but if hard to start the lever may be thrown too far, and sudden starts in some classes of work are costly. The resistance coils must be proportioned to secure close control. A desirable form of controller is one that can be removed bodily in case of trouble, and in which the frame and reversing switch and brushes assembled can be carried in stock ready for the insertion of a suitable set of assembled resistance coils. The individual resistance coils should also be renewable. This reduces the necessary stock of spares and is very convenient.

Series reversible motors, similar to those used on street cars, are employed on direct current cranes. They are usually wound for a 220-volt circuit, but 110 and 500-volt circuits are occasionally used. The street-railway type of motor, as developed by the large electrical concerns, is a very satisfactory machine for crane service. These motors are made in quantities and hence repair parts can be obtained with little delay. They are completely enclosed and very nearly fool proof. A heavy overload can be carried for a short time without danger, and they are built to start under full load. The speed of the motor depends upon the load.

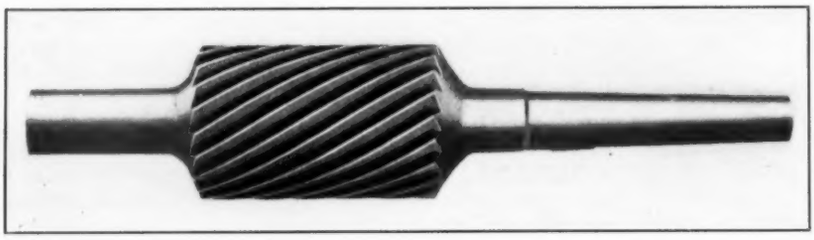


WIRING DIAGRAM 220-VOLT CIRCUIT.

The accompanying wiring diagram shows the connections for a three-motor crane. Each additional motor on the trolley requires two more trolley wires and a controller. If shunt solenoids are used, two trolley wires must be added and the hoist controller would have special contacts for it. Magnetic brakes are occasionally applied to the traveling mechanism. In any case, the connections are the same as on the hoisting circuit.

Self-Hardening Steel Milling Cutter.

We show herewith a milling cutter used by the Straight-Line Engine Company for slabbing connecting rods. The special features deserving attention are that it is from Sanderson's annealed self-hardening steel, is 5 inches diameter, 7½ inches long



SELF-HARDENING STEEL MILLING CUTTER.

in the cut and about 21 inches long over all.

It was hardened without a sign of a crack and without warping to any extent. By permitting an increase in speed and feed, it reduced the time of the work one half.

It will be observed that the spiral is of much shorter pitch than the usual American practice, which possibly accounts for a part of the increase in speed of the work.

Indexing Books and Papers.

BY FRED H. COLVIN.

People have different ideas about books. Some—as the woman who didn't care about the titles if the binding only matched her library carpet—think most of the appearances. Others have such a reverence for books that they are handled with gloves and almost idolized. It seems as though a middle ground might be the more sensible and books be treated as practical helps to a better understanding of things. They are, in fact, tools to enable us to do better work. Of course this applies particularly to mechanical books.

When we buy a book we expect to find

PLANIMETER—HATCHET

AMERICAN MACHINIST

July 17, 1902. Page 1017.

Ill. Art. by Frank B. Kleinhans

Good.

American Machinist

THE CARD INDEX APPLIED.

in it much that is of value in our line of work, or at least that interests us. We read or even study it to become familiar with it. Few of us have memories good enough to retain more than a general idea of it, but this is usually enough *if we can put our hands on just the book and place we want.* How often can we do this?

We read some thing of especial interest in a book or paper and resolve to remember it, or at least where we saw it. Most of us do neither, and in six months, if not before, couldn't tell to save our lives where to find it without a hunt—and we usually want it in a hurry when we do want it.

This is what prompts the turning down of leaf corners to mark a place, but after you turn down a few dozen they lose their significance. A better way is to note the page numbers on a fly-leaf with a little index of your own, or if the book happens to be well indexed mark beside the references you want. If a few marks in a book—notations or underlining—makes it of more value to you, by all means do it.

You may even have a few books whose sole value to you is in a few tables or rules. Isn't it better to cut them out *if you have a place to keep them* than to litter up your bookcase with a book of no further use to you?

With your periodicals it's a worse job to remember when and where you saw that especially fine article. Was it in this paper or that—in December or March?

Perhaps you've tried note books—carefully indexed, of course—and found the E's and T's were altogether too numerous while many of the other letters had few entries. Then, too, you've indexed some things you didn't want and had to cross 'em out. But did you ever try cards? Not a euchre deck, but the standard index card, 3x5 inches. Keep some handy when looking over any book or paper, and when you come across a good thing jot down the subject, name of book and page, like this, subject first *always*, so as to be seen at a glance in looking over your cards, which should be filed alphabetically in a box of some kind. You can get a little one for a starter, with 200 cards, and a set of alphabetical guides for half a dollar, if you want to try the experiment—and it's worth trying, too.

Of course, you say that the books and papers all have indexes. But if you don't know which book or paper it's in, they don't do you any great amount of good. The plan is to have *one general index*, where you can find something, and your 50-cent box will just give you a taste of the advantage of the plan. It will make your books and papers of double value to you.

There are many points about indexing that will be mentioned later, if the editor permits. But don't get the idea that this plan is for your superintendent only—it's for *you*, too.

Railroad Brass Founding—Driving Brasses.

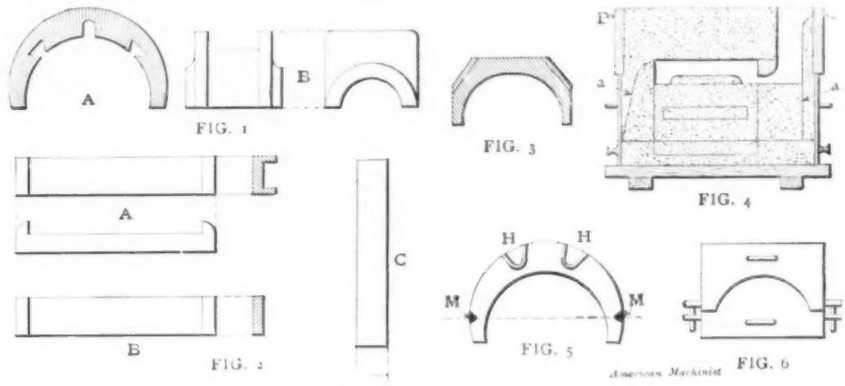
BY C. VICKERS.

The brass castings used on locomotives are known to the trade as "driving brasses," "ro ' brasses," "gibs," "sticks," "truck brasses," "bells," and so forth. Driving brasses are the bearings of the wheel journals, shown in section at *A*, Fig. 1. In weight they vary from 35 to over 100 pounds, 65 pounds being the average. Rod brasses *B*, Fig. 1, are used on the connecting ro l where it grasps the wheel crank-pin. The gib or slide is shown in three styles at *A*, *B*, *C*, Fig. 2. Sticks, as their name implies, are merely sticks of brass, sometimes round and sometimes hexagonal in section, and varying in diameter from ½ inch to 3 and sometimes 4 inches; in length they average 14 inches. They are cut up into nuts, washers, etc. The truck brass is shown in section at Fig. 3. It is the tender journal bearing. There are numerous other castings required for locomotives, such as oil cups, number plates, hand wheels, levers, etc.

There are several different ways of making driving brasses, the differences consisting mainly in the manner of gating and the temperature at which the metal is poured. They are very easy castings to "lose," and the causes of such losses are: scabbing of the bearing, which makes sand holes on the back of the casting; "shrinkage," which also shows on the back, making it hollow, and "running dirty," which produces an unsightly back. In shape a "driver" is an arch, and its back is the top of the arch. While defects at this point do not interfere with the usefulness of the bearing portion, still railroads that buy their castings from outside concerns expect good work, and generally refuse to accept castings that are shrunk or dirty, although when they make them themselves they are not always so particular.

In preparing to mold a driver, when there is no match or follow board, the pattern is placed back down on a smooth board, strips of wood are blocked under each side to prevent rolling, and the core prints for the babbitt cores are adjusted in their places. Before placing the nowel to be rammed with sand, arrangements must be made to bring the joint of the flask level with the line of parting on the pattern. It will be noticed that the outside of the driver is rather more than a half circle; consequently, it must be parted the same as if it were a bushing—that is, at the half of the circle—so the nowel must be blocked up before being rammed. The best way to do this is to take upsets or frames and place them over the pattern, building up from th smooth board until the parting line is reached, when the nowel is placed in position. Sand is then sifted upon the pattern and, if there is a recess in it to form an oil chamber, the green sand core should be well nailed, after which the sand can be well tucked around the core prints, and if they are held in

place by nails, the nails must be withdrawn at this stage. The sand may then be filled in and rammed with the peen well around the sides and ends, but not over the pattern if the nowel is not yet filled; repeat the operation of filling in sand and peening, after which finish the ramming with the butt in the usual manner. Strike off and bed on the board, then remove the board in order to vent, which is the most



MOLDING RAILROAD BRASSES.

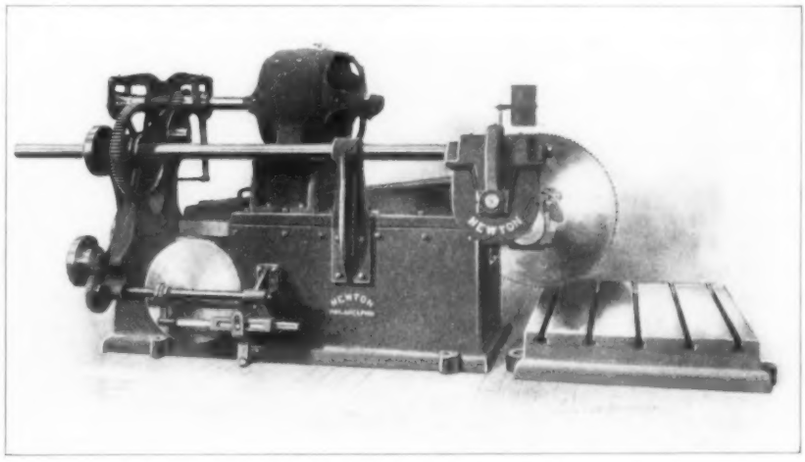
important part of the operation, as upon it depends the success of the casting. First, scoop out a broad, though not too deep, channel from end to end of the flask and right over the bearing; then, with a vent wire as thick as a match, thoroughly vent the bearing to within a quarter of an inch of the pattern. To do this, first drive the vent wire down to the pattern, then lift it up a quarter of an inch and hold it at this place or put a mark on it, and then drive the wire down to that mark for all subsequent vents and until the bearing is thoroughly vented, after which all the holes are closed by rubbing the fingers along the channel, which will prevent a "bottom run out" should the metal get into any of the vents.

The bottom board is now replaced, and the mold is rolled over, the smooth board and the upsets are removed, the loose sand is cleared away from the pattern and the parting is made. In doing this the sand is well banked against the pattern at each end, as shown at *a a*, Fig. 4. Parting is dusted on and the cope adjusted. If the cope is not high enough it should be built up by upsets, as shown at *B*, Fig. 4, and should be not less than 4 inches higher than the back of the pattern. It is a good plan not to sift sand directly on the pattern, as it rolls down the sloping joint, and, carrying away the parting, causes a "bad lift," to avoid which the sand is spread over the slopes by hand, starting at the bottom. After the sand is sifted and tucked, the sprue may be placed in position. For the method of molding we are now considering, it should not be less than 2½ inches in diameter. The cope may now be rammed by peening well at the sides and tucking with the fingers at the ends, until the sand reaches the top of the cope, when the peening can be finished by going over the entire mold (lightly, however, over the pattern). It is now butt-rammed, leveled off and the sprue removed and the hole widened to a bell shape. Before being lifted off, the cope is vented, and, as the sides are where the largest body of sand is, that is the place where the vent wire should be used and not on the top of the pattern. A rap will greatly facilitate matters in removing the cope, after which the gate is cut, and the pattern is removed. *H H*, Fig. 5, show where the gates are cut, and how they should be filleted to enable them to be broken off while the casting is hot.

In finishing the mold, the green sand core, forming the oil chamber, should receive careful attention. If the sand is of an open quality it may be lightly swabbed with water, and in any case it must be made firm and solid by judicious sleeking. The babbitt cores are fitted to their prints and nailed, and all interstices between core and print are filled in. The mold is now finished by removing all loose sand and flour or plumbago may be dusted on. Before the mold is closed, the sprue must be cleaned out; the cope can be stood on its pins on the floor, or rested over an empty flask of similar size if it has no pins, while the bellows are used to remove all dirt from sprue and head.

The method of molding just described is in every-day practice in shops that possess no special flasks for this kind of work. Such a flask is shown in Fig. 6, which gives an end view. With this flask the making of a parting is simplified, no banking of the ends being necessary as at *a*, Fig. 4, and the labor is still further lessened by the use of a match or follow-board. All shops do not possess such facilities, because the number of orders for such castings would not justify the expense, therefore the method outlined above is the one usually adopted.

As to the manner of gating: In some shops, while the position and size of the gates are substantially as shown, a smaller sprue is used, and a riser is occasionally taken off at the other end. In such a case, if the metal is not used hot, the sprue being inadequate to properly feed such a casting, the back will often be shrunk or hollow. Another method of gating is to carry small gates down to the joint of the mold, as shown at *M M*, Fig. 5. In this case also the metal must be poured hot or a heavy riser must be taken off the opposite end to guard against shrinkage. Theoretically, this last manner of gating is a good one, as the metal enters the mold at the bottom, or as near to it as is practicable, and ascends gently. The object in having the gates small is to enable the sprue and head to be kept full of metal while pouring, and so prevent the ingress of dirt to the mold. If a riser or feeder is not used, however, the tendency to shrink is greatly enhanced, and where a riser is used to overcome such tendency, the labor of making the mold is increased, first, in making the riser, and, secondly, because of the increased size of flask necessary to accommodate the same; so that, all things considered, the method of gating first described has a great deal to recommend it.



COLD-SAW CUTTING-OFF MACHINE.

A New Cold Saw Cutting-Off Machine.

The accompanying half-tone illustrates a new electrically driven cold-saw cutting-off machine built by the Newton Machine Tool Works, of Philadelphia. This machine was designed especially to meet the

demand for a direct-coupled motor-driven tool and the drive, instead of being an afterthought, is embodied as a part of the machine itself.

The machine is designed for cutting off the risers on steel castings up to 13 inches in diameter, using an inserted tooth saw, the saw being carried on a spindle head or ram which feeds forward in the bed. The saw is made flush at the outside, so that castings of any length or size can have a riser cut off in any position and up to the diameter named—that is, 13 inches. The machine is driven with a 10 horse-power motor which is geared to the driving shaft. The armature shaft is belted to an extra pulley to give a quick motion to the spindle head, and the drive is connected with a friction clutch, as is also the quick-return motion, so that the motion of the saw can be stopped and the quick movement obtained by means of the motor, in either direction, independent of the drive of the machine.

A Special Radial Drill.

The illustrations show a motor-driven portable radial drill designed and built by Roos & Mill, of Cincinnati, Ohio. This machine was designed for drilling and counterboring horizontal and vertical holes in electric motor yokes of from 6 to 15 feet inside diameter, and is in operation at the plant of the Bullock Electric Manufacturing Company.

To perform the work, the machine is lifted by a crane and placed exactly in the center of the yoke and rigidly clamped at the circumference of the base to the T-slotted floor plate, where also the yoke is bolted fast. The center line of the spindle in its horizontal position runs exactly through the center of the column and all horizontal holes drilled in concentric surfaces will therefore be drilled in line with the center.

The sleeve, carried on the inner column or post, is supported at the bottom on conical and sideways on cylindrical anti-friction rollers. It can be locked quickly and securely by means of a clamping ring and an eccentric pin shown near the bottom of the sleeve.

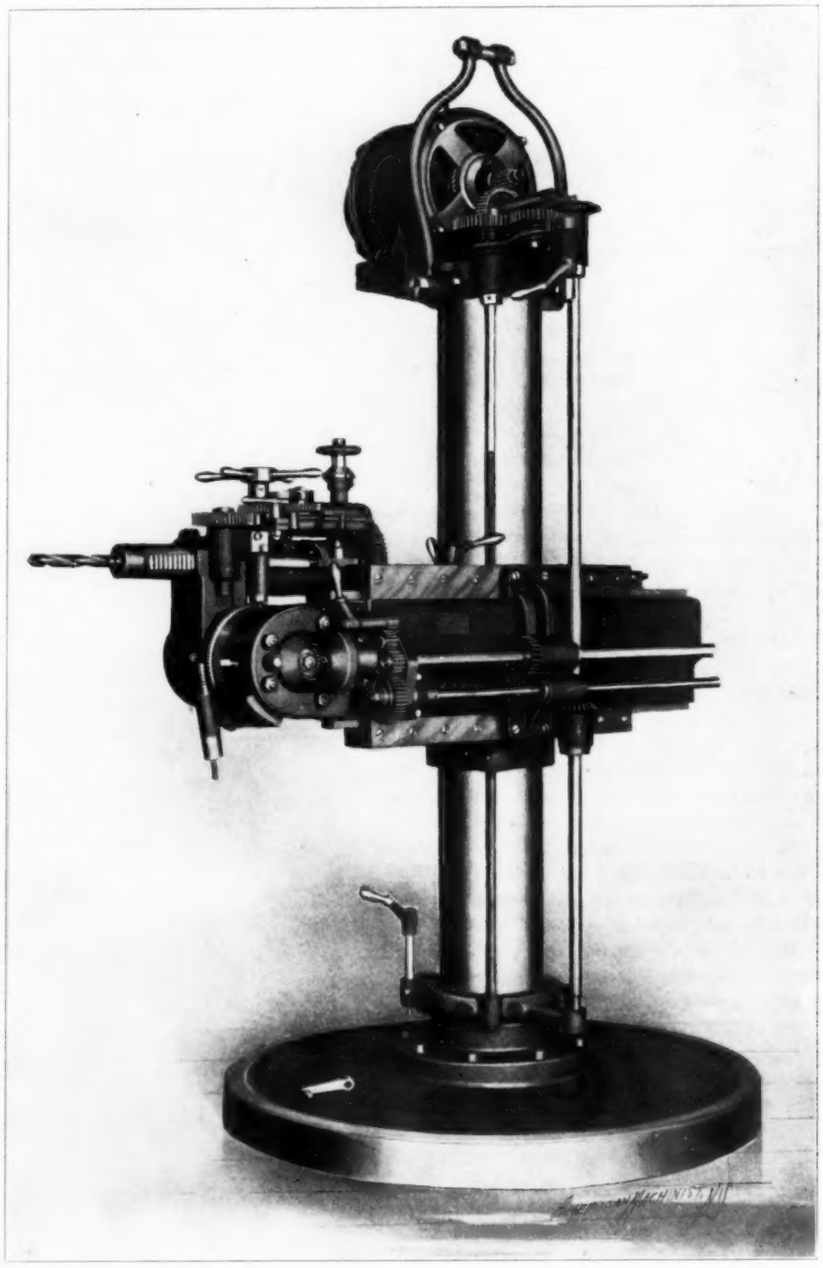
The saddle, which surrounds the sleeve and supports the sliding arm, can be raised and lowered by power and accurately adjusted by hand. This saddle has a feather, which fits into the spline of the sleeve, is split and easily locked in the required vertical position by clamping bolts.

The arm is of box girder form, and can be moved in the saddle by power, the screw, nut and gearing for this purpose being clearly shown in the illustration. The head is mounted at the end of the arm and swiveled by means of worm gearing; it is graduated in degrees and located with the spindle, either horizontal or vertical, by a dowel pin.

The spindle has a positive feed with four changes, has a quick-return arrangement and is back geared direct from the spindle driving gear. The back gear can be thrown in and out when the machine is running.

The column at the top, where the motor is placed, is provided with a yoke by means of which the drill is suspended on the hook of the traveling crane.

This machine, when mounted on a slotted base and provided with a work table, will make a strong and conveniently operated stationary radial drill.



SPECIAL RADIAL DRILL.

Bracing up a Shop in England.

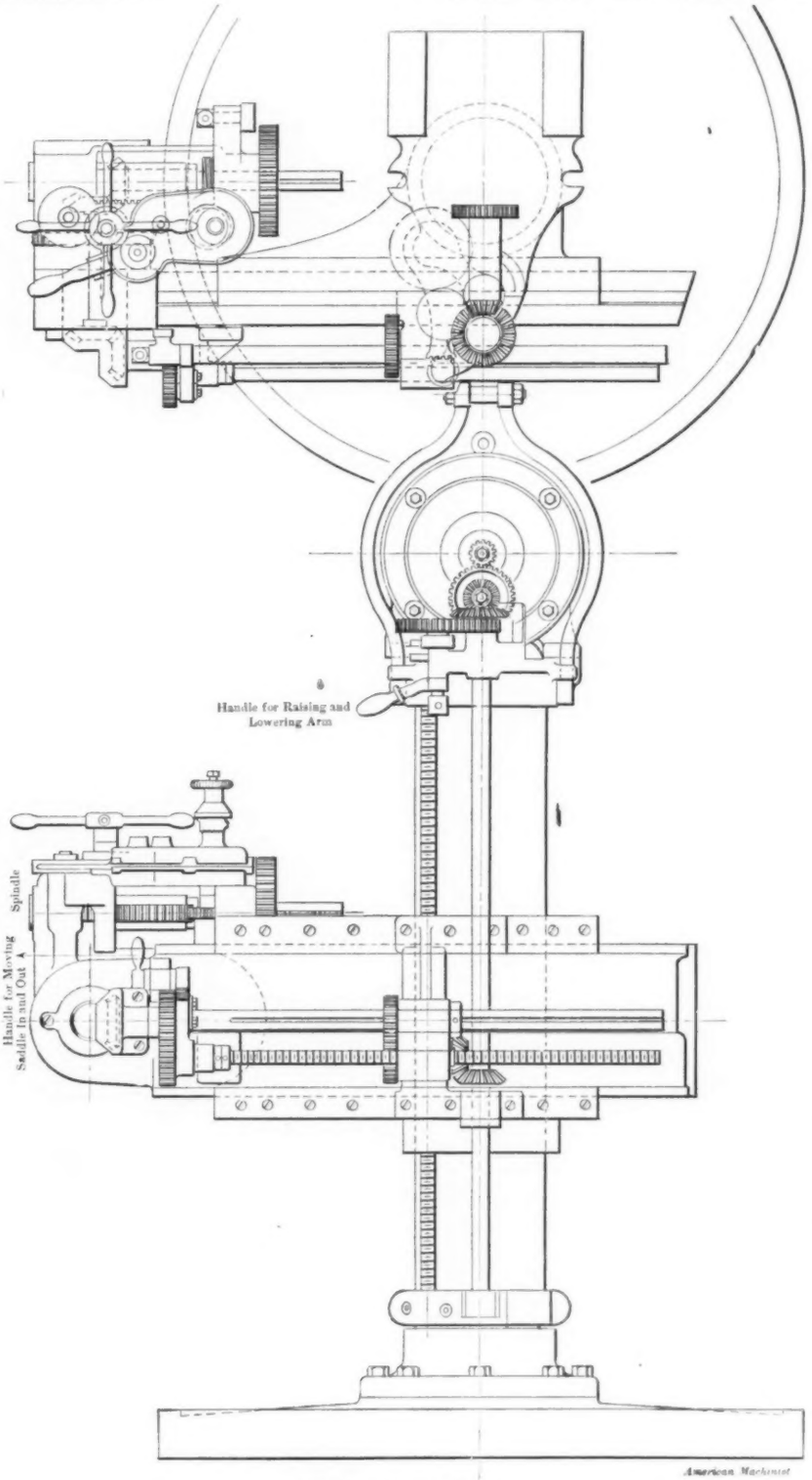
BY FRANCIS W. SHAW.

"It's a serious matter. We've been in this business now for over fifty years; have made a pile of money out of it; used to have the command of the world's markets. We're turning out a better reaper than ever we did, and yet we're being ousted everywhere. Prices are cut so fine that we can't even make a profit. We have no complaints about the efficiency of our reaper, and yet the trade is going elsewhere." So said the senior partner in an old-established concern.

Replied his junior: "I've been studying the thing now for a long time, and I have come to the conclusion that there's nothing for it but to get cheaper labor. It's evident that we, having been in the business for fifty years or more, know everything that is to be known about making reapers; no one can beat us at the game unless they cut the wages bill down. No! I don't think anyone can beat us there."

Again speaks up the senior: "Well, I've an idea myself that it may be that our men are doing less work than others. We have

got so lax that the men take advantage of our kindness. What we want, I feel convinced, to cure this, is an up-to-date manager, and I would suggest that we advertise for one."



SPECIAL RADIAL DRILL.

"Perhaps you're right, and we'd better try what can be done in this direction first."

And hence the advertisement—"Wanted, a manager for a reaper concern, one familiar with modern practice," and the usual rest of it, which appeared in the orthodox paper, resulting in the setting on of a young fellow about thirty years of age.

He arrived, dressed up to the knocker, introduced himself and—"Would like to have a look round the shop before looking out for diggings."

"Oh, yes. Here, Tom, just take this gentleman around."

In about ten minutes he was back again into the office.

"Well, what do you think about it?" asked the boss.

"Why, the whole shop wants bracing up."

"What! the roof coming in?"

"Oh, no; I mean the men, the machinery, the whole thing. If I can't have a good bit of liberty here, I'm afraid I can't start; but if you'll allow me this, then I'll guarantee to double your output for the same labor expenditure."

"Well, there's no objection to that, but we're afraid you can't teach us anything in the reaper business. What experience have you had?" "Oh, I remember, two years with So-and-So." (Aside—"One of our successful rivals.") "Well, we'll allow anything in reason, but keep down the expenditure as much as possible."

The machine shop was a dirty hole, the machinery in it was dirty, the workmen—as if to keep it company—were dirty, their clothing dirty and their manners and conversation dirtier. Within a week the shop was turned upside down. The floors gradually presented the unwonted appearance of freedom from litter, the scrap wherewith it had hitherto been garnished having disappeared; the machinery was cleaned and repainted, tools were collected and cleaned from an accumulation of dust, grease and chips, and stored in a rapidly partitioned off part of the room. The dust begrimed walls were white; through the windows shone the light with an intensity greater than it had for ages; ventilators which were almost buried in dirt and dust and rendered further unnoticeable by the gloom were rediscovered and opened to admit fresh and allow the exit of the vitiated air; rapidly improvised fans, consisting of thin vanes of wood mounted upon the rotating shafting, whirled the air about, rendering less trying and tiring the hot summer weather; in fact, everything appeared to have had consideration that affected the well being and comfort of the work people.

In the meantime our friends, the employers, had kept their eyes open and sundry conversations took place.

"Well," said the senior meditatively, "I like the man's ways to some extent. He goes about everything in a business-like way. The shop looks as if it ought to turn out more work, but I'm afraid we're being run into a terrible expense. Look at Tim Healy. He's done nothing whatever for the last fortnight but sorting out the shop tools and putting them in order in that new fangled storeroom in the machine shop. And what good that's going to be, I don't know. Fancy every man in the shop losing time fetching the tools he wants; better far to allow each man to keep his own tools handy by him, if even we have to have a double stock; and Jim, Bill and Tom have done absolutely nothing towards the last reaper order."

His junior, who had been taking particular note of the trend of things, replied:

"I think I begin to see a glimmer of rea-

son in our man's apparent madness. I thought at first similarly to what you yourself have just stated, that the tool storeroom was rather too too, until I noticed that a more convenient position might have been chosen leading me to ask myself the question 'Why has he chosen that particular spot?' and upon looking round I noticed that it was handy by the small tools, the grinder, milling machine, the accurate lathe, and it struck me then that he intended to utilize these tools chiefly for keeping the small tools in order; and then it is a question whether the provision of a quantity of tools for each man and each man to look after his own, is really a good point in our old system, for the men are too careless to look after them efficiently. Yes, I consider we have been blind."

Although the shop now bore a decent appearance, one thing yet remained the same: dirty men still did the work. In the morning they came with faces dim with the fast dye of workshop quintessence, their old Sunday clothes upon them shining with an iridescence due to the presence of greasy swarf, well polished by contact with the machinery. It was said that the only time they presented themselves with clean faces was on Monday morning, the lapse of time since Saturday having given the grime a chance to come to the surface and be washed away.

The men kicked against many of the innovations; a meeting was called to discuss matters, and a strike was then decided upon. However, unanimity could not be gained and thus the decision was not acted upon. By degrees, however, the new condition of things soon made itself felt and seen upon the men. Their manners became more gentlemanly, their appearance more businesslike, their language more endurable, their skin and clothes cleaner; overalls appeared; scarfs gave place to collars and ties, boots were "shined"—some went even so far as to change their walking boots for easier shop slippers. Their work improved both in quality and quantity—they were for the most part pieceworkers, and their pay increased proportionately. And when they left work for the day there departed a comparatively orderly set of well-behaved, neatly attired men—an apparent credit to the community instead of the "used-to-be" dirt-begrimed crew, which the town spoke of as So-and-So's "greasers" by reason of their greasy appearance.

There could not be a change like this in their shop ways without its having some influence upon their home ways, and what is to be the ulterior effect of the change, who can tell?

It beats me altogether to think how ever it is possible that employers' eyes can remain closed, after seeing the effects of the new order of things upon their fellow beings. There are thousands of persons trying to instill into the minds of the masses a common honesty of purpose. Do employers know that they have far greater power in their hands than the whole of the preachers can ever hope to have?

And to run your shop under pleasant conditions will cost you absolutely nothing; nay, for every shilling you spend you will be repaid in pounds. This is not mere vaporizing, but a plain unvarnished statement of proved fact. The more you study your men's interests, the more will they study yours.

But, if you inaugurate the new system, don't be disappointed if immediate effects are not seen; success will assuredly come in time, for no man can constantly have kindness thrust upon him without in time being compelled to reciprocate.

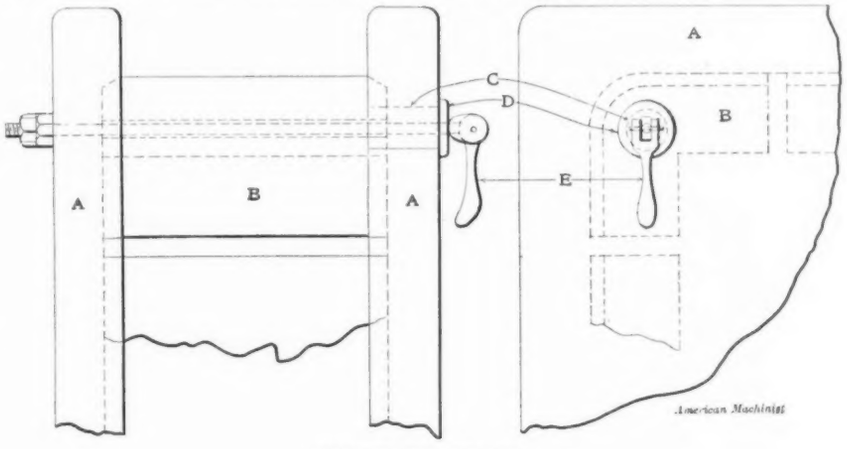
Birmingham, England.

Letters From Practical Men.

A Magnet Winding Jig.

Editor American Machinist:

The sketch shows the method of clamping a magnet winding jig. *A* is the housing, *B* the winding core, *C* a hole in *A*, *D*, washer; *E*, eccentric clamp. The end of the bolt is flatted and to it the eccentric clamp is hinged. Washer *D* is slotted at one side to slip over the bolt. The sketch shows one corner of the jig ready for



MAGNET WINDING JIG.

operating. When the core is wound and ready to remove, release eccentric clamp *E*, remove washer *D* and remove housing *A* by placing eccentric *E* through hole *C*. A fine adjustment can be made with nuts on the other ends of the bolts.

MILWAUKEE.

A Camera Improvement.

Editor American Machinist:

I am under the impression that quite a number of the AMERICAN MACHINIST'S readers use a camera more or less, and as someone may wish to get an enlarged image nearly if not quite up to full size, I will describe how I increased the size of the object on the ground glass.

The camera is a 4x5-inch Premo B, and, as the front door is only 5 inches wide, the bellows will not reach much beyond the 5-foot mark, and as that did not give a view on the ground glass over 1 inch square, and as that was too small to be satisfactory, I decided to increase the size if possible.

As I had two each plus and minus spectacle glasses, I decided to try the effect of placing them in a ring on the outside of the regular lens. By accident the two lenses were only about 1-32 inch smaller than the brass lens holder on the camera, and on hunting around I found a piece of dead-black curtain goods. This I cut to length to go once around and of width sufficient to hold the loose lenses.

I placed the plus lens in first, but it was too strong; I then put in one each plus and minus; this, with the camera slide pulled about one-half out and with the object 7¼ inches away, gave me about the desired size, with a good, sharp definition. The object was focussed under a glass. It was necessary to tie the ring of curtains goods on with a piece of twine to keep it in place. G. SCHNEIDER.

Bracing Up a Shop.

Editor American Machinist:

"Dutch," at page 1520, seems to be a little offended at my letter in regard to bracing up a shop, and I can scarcely see I fully agree with him that the shop I told about was like the proverbial rotten egg; but, whether he believes it or not, I did bring order out of the chaos, and that in a remarkably short time. Returning to the first paragraph, the nature of our work was such that we were free from the trouble of putting "gage size drills *just* where they belonged," as we were not doing tool work or anything small enough to require them.

The second paragraph describes his shop as so different from the impression created in my mind by his first letter at page 1022 that on reading it I began to think that perhaps I had been, like 'Rastus' coon dog, barking up the wrong tree, so I straightway looked it up. To be candid, on reading the letter in the light of my later

information, the case did not seem nearly so bad as it had seemed at first. You see, these things create different impressions according to the varying mental attitudes of writer and readers; in fact, what we say or do may be understood very differently from what we intended. As an illustration of this, I will relate an anecdote from my fund of personal experiences:

Some years ago I resigned my position as foreman in a certain shop to accept what seemed a better place. My resignation was tendered in writing, stating where I was going and that I would leave on the following Saturday. On Thursday morning Mr. English (that wasn't his name, but it will do as well as any), the proprietor, came out into the shop and told me that if it would be of any service to me he would pay me up to Friday evening and let me have the unexpired time to myself. For a moment I was tempted to refuse, then it flashed through my mind that he wanted me out of the way, so I accepted. Now, the principal feature of the transaction, to my mind, was that I was losing a day's pay, while I dare say Mr. English believed himself very generous in offering to pay for two days' vacation out of the three he was giving me. In the light of my present knowledge, I am free to confess that I regard Mr. English as a kind and well-meaning man, yet his manner was peculiar and he had the faculty of exasperating me beyond measure, though he doubtless never intended doing so. It was all due to our very different points of view.

The toolroom is a means of making a large body of men orderly and of reducing the amount of supervision required to keep them so. Where a small number of men—less than twenty, to be specific—are employed, the foreman can enforce orderliness without this aid—if he has the proper qualifications.

The third paragraph of "Dutch's" protest merits my most hearty and unqualified commendation. May his shadow never grow less.

As to the fourth paragraph, I confess that the personal orderliness of a man who can sit at home and tell just what is to be found in the twenty-seven pigeonholes and twelve drawers of his desk at the shop is phenomenal. I couldn't do it, and think there are few who could. This, however, fully accounts for the wrong impression created by his first letter. A man who is so remarkably orderly would naturally be captious in his criticism of others in whom the trait is less well developed, and a stranger reading his account of the faults of his men would naturally suppose them much worse than they actually are.

We are all glad to know that things are so much better than some of us had thought. We are glad that the toolroom improved them, as it always does when properly administered; and, finally, I personally hope that some day in my wanderings I may stumble into friend "Dutch's" shop and that he will then disclose his identity and tell me more of his experiences.

L. O. DANSE.

Detroit, Mich.

Indexing Periodical Literature.

Editor American Machinist:

The following plan of indexing such articles as are referred to at page 1454 by your inquirer, "Constant Reader," may prove as useful to others as it has to myself. Although I have not used it for the particular subjects shown on the forms herewith, it has proved of service in another line.

I use index cards 6x4 inches, ruled as on Form 1. Form 2 is a partial list of the various divisions and subdivisions into which the index is divided. On receipt of various papers and magazines, I glance through the contents and select such articles as I wish to index for future reference. By reference to the index list, Form 2, I see at once the number indicating the divisions in which I want each individual article recorded, and to which I would look if studying that particular subject. This number I mark plainly on the article and note in the margin any remarks I wish, and my part of the indexing is then finished. On a junior member of my family devolves the listing of these articles on the card as indicated by the number marked. The cards being ruled on both sides will contain a good many articles, and when one is filled another bearing the same number is placed with it. It will be seen that Form 2 leaves plenty of blank numbers for the insertion of further divisions and subdivisions of the index in their proper place if found advisable. By referring to the index card, Form 1, I have a list of all articles which I may have seen on the subject of molding machines.

As regards articles in newspapers or

Section	*Index*	*Sub-Index*	*Index No.*
Mechanical Engineering	*Foundry*	*Moulding Machine*	*1*

In	*Date*	*Article*	*Remarks*
Am.M.p.731	*22 May, 02*	*Machine Moulding*	*Moulding Wheel Guard*

American Machinist

FORM 1 INDEX CARD.

	Foundry	*Moulding Machine* *Flasks* *Fuel*	1 2 3 4 5
	Machine Shop		6 7 8 9 10
	Power & Transmission		11 12 13 14 15
Mechanical Engineering			16 17 18 19 20
			21 22 23 24 25
			26 27 28 29 30
	Miscellaneous	*Day and Piece Work and Prem. Plan*	31 32 33 34 35

American Machinist

FORM 2 INDEX CARD.

such periodicals as I do not desire to keep, I cut them out, paste them in an ordinary scrap book and index as above.

KENNETH FALCONER.

A Small Hydraulic Installation.

Editor American Machinist:

For some processes of manufacture, nothing is superior to hydraulic transmission, but the cost of installing it deters many from using it who should do so.

Where I am employed they put in a hydraulic press operated by a direct-acting steam pump which pumped the operating fluid directly into the press cylinder without an accumulator. Of course, in time it became necessary to put in additional presses, and as the direct-acting method of operating had not been fully satisfactory, it was decided to put in a complete hydraulic system with an accumulator. The cost of a pump of suitable capacity was moderate, but an accumulator of sufficient size, of the weighted type, with its safety valves, etc., was expensive and objectionable on account of the space required and the expense of keeping it in good operating order.

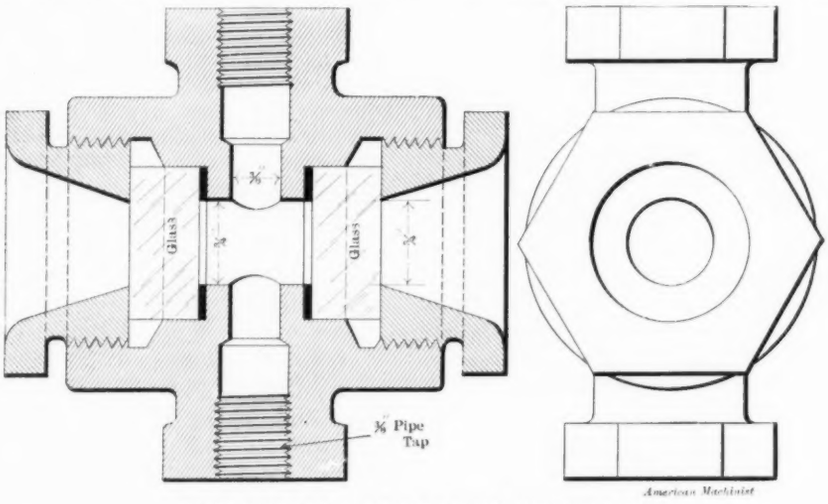
The steam-hydraulic accumulator was duly considered, but it also was expensive, and seemingly costly to operate on account of loss by condensation and wear of packings. The variety of work done on the presses was such that it was desirable to use pressures from 500 to 2,000 pounds per square inch at will, and if the system would permit of easy adjustment to the pressure needed there would be considerable economy in operation. One very favorable feature was that a 10 per cent. variation in pressure from the desired point was permissible.

All this pointed to an air accumulator as being the ideal thing for the conditions, but I was unable to learn of any precedent of use with such heavy pressure as 2,000 pounds. Yet there seemed to be no particular reason why it would not work successfully.

For the accumulator a steel bottle 14 inches diameter and 7 feet long was ordered, but for some reason the firm who took the order, after a long delay, offered as a substitute a bottle 9 inches diameter, 10 feet long. As one of this size was too small, it was necessary to get two of them. They were set vertically, close together and connected top and bottom so that they acted as a single one.

In this kind of accumulator, it is necessary to have some means of showing how much, or at least when there is enough, water in it; for if the water is all drawn out and air escapes into the presses, it is a permanent loss of pressure which requires special means of restoration. Of course a sight gage was the thing wanted, but a sight gage that will stand 2,000 pounds per square inch is not a common article. Various substitutes, magnetic and mechanical indicators, were thought of, but none of them seemed practical or r liable, so it was decided to make peep sight gages.

The accompanying drawing shows the construction of one of them. The sights are plate glass 11-16 inch thick and the metal is brass. It has frequently stood a pressure of 2,500 pounds per square inch without failure. One glass was broken, but that was not due to the working pressure, it being caused by improper setting of the glass in the gage.



WATER SIGHT GAGE FOR HYDRAULIC ACCUMULATOR.

It is important to have both surfaces of the glass flat, smooth and parallel. It is also safer to have a tough paper ring between the screw gland and the glass, so that when screwing down tight it will prevent the metal from grinding on the glass. The packing ring under the glass is leather.

Two of these gages were used, connected by ⅜ inch heavy pipe with the top and bottom of the accumulator, one being located in the pipe 4 feet below the top and the other 5 feet below that. When working the water is supposed to be kept between them and especially not allowed to get below the lower one. Just below the lower sight is the connection to a pressure gage. At the top and bottom of the vertical gage pipe angle stop valves are placed, the upper one having a chain wheel on it with the chain coming down to a convenient hight so that the valve can be shut quickly should a gage fail under pressure. The two bottles are connected at the bottom by 1½-inch pipe and to this the pump pipe and press pipes are connected.

A triplex single-acting belt-driven pump 1¼x5 inches was installed for operating the system. It was necessary to charge the accumulator with air pressure of 300 to 500 pounds when the water stood at the lower gage. The tank from which the pump drew its supply of water was placed so that the fluid would flow into the pump by gravity. Into the suction pipe an air pipe was tapped having on it a throttle valve.

To pump air the air pipe was left open and the water suction pipe was throttled to allow enough water to go with the air to seal the valves. It was found that 300 pounds was the highest air pressure that could be obtained by this method. To get a higher pressure an air pump 3 inches diameter and 6 inches stroke, single-acting, was mounted and driven by a crank on the end of the pump shaft. This pump had a suction pipe to the tank and the air pipe was placed in it, and the discharge pipe was run into the suction pipe of the triplex, making a compound air pump. The mixture of air and water is pumped till the accumulator is filled to the upper gage, when the water is drawn down to the lower gage. This is repeated until there is enough air to produce the required pressure when at the lower gage.

With the pump running 100 revolutions per minute, it takes 3½ to 4 hours to get up 500 pounds air pressure. It requires some experience to find how much water must be let in with the air to get up the pressure in the least time. In operation there is a gradual loss of air, probably partly from leakage and partly from absorption by the water, and this loss is supplied usually whenever the system is idle.

To get automatic control of the pump when in regular operation a belt-shifter was used, which was operated by a plunger actuated by the pressure in the system, which stopped the pump when the pressure got too high. The plunger was ⅜ inch diameter and was weighted with removable weights, which were changed to suit the pressure required.

This is not a satisfactory plan of control, and it is better to have the pump run continuously and control the pressure by having a switch valve in the pump discharge pipe, operated by the controller plunger, so that when the pressure reaches the maximum point it will lift the valve and allow the water to discharge back into the supply tank or the pump suction pipe. It is of course necessary to have a check valve between the switch valve and the accumulator, so that the pressure will

not force water back through the switch valve.

More pumping capacity was soon required, and a duplex, direct-acting steam pump, 14—2x10 inches, was put in. To control this pump it was decided to put a throttle controller on the steam pipe to be actuated by pressure from the accumulator; but it was discovered, when corresponding with makers of pump regulators, that a Mason differential pressure regulator would give complete control, the pump itself serving as part of the controller. The standard Mason regulator was used and the screw adjustment of it proved to be sufficient to get any pressure from 500 to 2,500 pounds in the accumulator, and it is so sensitive that a fall of 20 to 30 pounds in the accumulator starts the pump. This pump will not pump air, and the air charging is still done with the triplex pump. It will be observed that the accumulator is in fact nothing but a large air chamber for the pump, provided with a means of charging it with air. It is very interesting to watch how promptly the steam pump responds to the demands of the presses, and where some variation in the working pressure is allowable this system is so good that it may be adopted with entire confidence in the results. In operation there has been found no need for safety valves on the pipe lines, as they are all comparatively short, and of course the accumulator does not need one, as the air pressure is perfectly elastic and without inertia.

I have spoken of water being used in the system, but a partly refined grade of petroleum is really used instead of water. This, however, is a possible source of danger, and it was with some doubt that I watched the first charging of the accumulator, because an air pressure of 2,000 pounds on top of oil, and at a sufficient temperature, would be a combination for producing a first-class gas explosion. However, the air pressure accumulated so slowly that the heat had time to radiate.

When the pressure is changed from 500 to 2,000 pounds it is done very quickly, but it does not increase the heat enough to seem near the danger point. In case of a fire there is no doubt that a very bad explosion would result as soon as the heat reached the right point, and where oil is used it would no doubt be best to have a valve on top of the accumulator, which would let off the air when the heat reached a given point; something like the automatic sprinklers used in buildings to put out incipient fires.

In hydraulic systems it is an advantage to keep the working fluid free from all matter large enough to lodge in the pump valves and cause trouble, and we tried to do this by putting a strainer on the suction pipe inside the tank, but this was frequently troublesome, on account of getting clogged so that the pump could not get its supply. To overcome this a special tank was made, of a rectangular shape and of a width one-half the length. Across this, in the middle, is a partition which reaches from the top to within an inch of the bottom.

About 1½ inches above the bottom, in one end, a brass cloth screen is located, which is easily removed, as it rests on angle-irons around the inside of the walls. All the discharge pipes from the presses project just through a cover on this end of the tank. The discharge from the pipes keeps the oil in rapid circulation above the screen and prevents it from clogging, and as it is easily removed for cleaning when required, it has proven a success.

The pump suction pipe is attached to the other half of the tank in the center of the bottom. The partition in the tank prevents air bubbles from getting into the suction half of the tank, as all the fluid has to pass down under the partition to get there, and this compels nearly all the air bubbles to be liberated in the first half. This is important, because all the air which goes into the duplex pump collects in the valve chambers and produces irregular motion with pounding.

The weak point in this system now is the operating valves at the presses. A valve is needed which is easily operated, reliable and durable, but we have no such one yet.

With valves as satisfactory as the rest of the system is, there would be no cause for complaint, and if any of your readers know of such a valve, I would be pleased to see some account of it in your columns.

BELL CRANK.

A Punch and Die for Slitting.

Editor American Machinist:

I was lately asked if a die could be made to punch out press-board pieces, .008 inch thick and like *A*, Fig. 1, with three cuts in one end. They were wanted by the hundreds of thousands and must be made cheaply. After I was permitted to make four cuts instead of three, I designed a little die that works well and turns them out at the rate of from 400 to 500 per minute from good material; but a good deal of waste from other work is used, which doesn't work quite as fast.

The die was made as follows: In a piece of 5x5x1-inch tool steel the rectangular hole was made just ¼ inch larger each way than the sample piece *A*. That ¼ inch was occupied by a heel on each of the blocks *C*, which were at the same time gages for the material to be punched and a support on the back side of the punch *E*, Fig. 3, while blanking them.

The cuts were to be ⅜ inch long. To make them the holes *F* in the die were made 5-32 inch longer than the cuts.

The punch *E*, Fig. 3, was made the size of the press-board blank, and to fit nicely in the die between the blocks *C* and the edges of the die.

The punches *H*, Fig. 3, were made 3-32 inch shorter than the punch *E* and 7-16x .237 inch cross-section (.237 being one-fifth of the width of the press-board), with the corners at J rounded a trifle to prevent eating off the tongues on the paper. The small punches were fitted into the punch plate and riveted on the upper side. The large one was held with screws and dowels. Next, two little push-out blocks *K*, Figs. 2 and 4, were made to fit freely in holes *F* with a small round base below the die. These are forced up level with the die by springs, not shown, pressing against the round base *L*, to discharge the tongues of the press-boards that are pressed down by punches *H* every time the press comes down, and were kept from projecting too far by the round base below.

As the material to be punched was soft, we needed a long guide strip *M*, about 18 inches long, with two support blocks *N* to hold up the material while it is being fed up and under the punches.

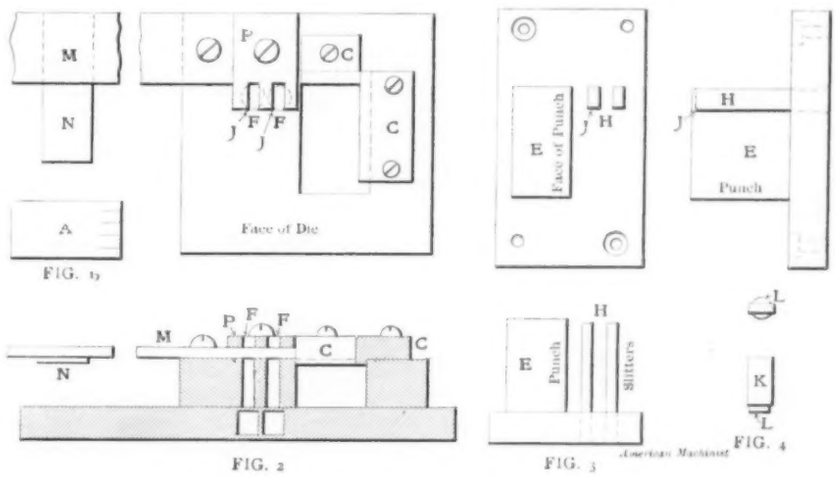


FIG. 1 FIG. 2 FIG. 3 FIG. 4

PUNCH AND DIE FOR SLITTING AND CUTTING OFF.

The die was screwed and doweled to plate *O*, which had two recesses for the springs mentioned above.

Eight sheets to be punched were pasted together on one edge and fed along guide-

strip *M* under the punches while the machine was running continually. The little stripper-plate *P* on the guide-strip strips the material off the small punches and leaves it free to move every time the punches are up.

The advantage of a die of this kind is, that you do not waste any material whatever, except at one edge of the sheet (the size of which is about 40x40 inches), where they are fastened together, and that could be reduced to a minimum by careful pasting or by holding the sheets together by light, suitable clamps.

Another advantage is the continual running of the machine without any self-feed attachment either on the die or the machine, as the sheet stops against block *C* every time the punches are up and it is pushed forward, thus allowing the machine to work continually.

I use the same kind of dies for punching zinc pieces of different sizes, from 1⅛x2 to 2x4¼, with square corners and a round hole in the center, ½ to ⅜ inch diameter, blanking them by cutting only the two edges every time, leaving no waste more than from the round hole and using the same simple self-feed, and I double the output by punching two thicknesses at a time and cutting directly from sheets 2x3 feet, without shearing into strips, at the rate of 120 to 160 a minute.

In making dies of this kind it is very important to have the blocks *C* high enough so that the punch operator cannot possibly get the material over the tops of them, as that would be sure to dull the die quite badly.

Another safeguard I put on some of these dies, in the form of a guide-piece on the top of the block that the material is fed up against, and reaching out over the sheet an inch and at the same time bent down, only leaving room enough between it and the die to let the sheets pass freely.

Both the die and the punches are hardened and drawn to a very light straw color. TOOLMAKER.

A Special Tool for Cutting Out Large Fiber Washers for Embossing Rolls.

Editor American Machinist:

In a shop in Brooklyn, where they make large embossing presses the rollers of which are made up of fiber washers forced on to machine-steel shafts, I saw a tool for cutting the washers from the sheets. This is shown in Fig. 1, and the manner of using in Fig. 2. In the shop referred to two sizes of washers are used, one size 15 inches in diameter with 4-inch hole, and the other 18 inches in diameter with 5-inch hole. The thickness of the fiber board is ¼ inch.

As shown in Fig. 1, the tool consists of a 1-inch drill with a cutter head beam *B* let through a slot as shown, and fastened by two screws. *C* and *D* are the cutter heads, which are finished to a good sliding fit on the beam, and *I* and *H* the cutters, which are hardened and tempered and let into split seats in the cutter heads and fastened by the screws *G*. The cutting tools are a trifle less than 1-16 inch in thickness and are given sufficient back and side clearance to allow them to cut freely.

Fig. 2 shows how the tool is used. A piece of 1½-inch planking is fastened to

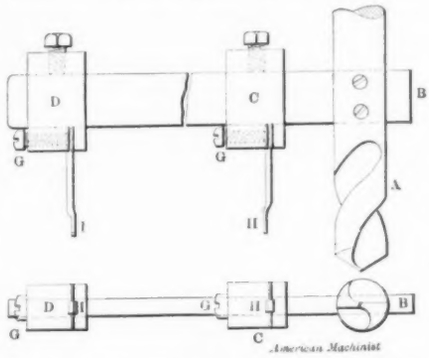


FIG. 1. TOOL FOR CUTTING OUT LARGE FIBER WASHERS.

the drill press table, and the table is clamped in central position. A small pin forced into the planking at the right serves as a gage for locating the fiber beneath the drill and also to space the washers evenly. The drill shank is fastened in the chuck in the drill spindle and the tool is rotated at about 40 turns per minute. The drill cuts first, and as soon as it has passed through the fiber and entered the wood the inside and outside cutters begin to cut. A slight pressure is all that is necessary to make the tools cut, the shavings curling up nicely, and as soon as they have passed through the fiber a quick raise on the feed lever causes them to pull free

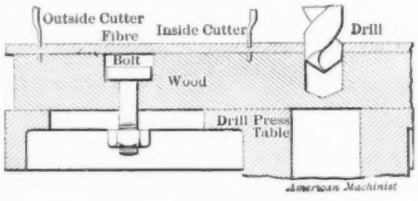


FIG. 2. THE TOOL IN USE.

and clear of the work. As will be seen, the tool cuts the inside and the outside of the washer simultaneously, and as the insides are used as washers for smaller sized rolls two washers really are produced at once. JOSEPH V. WOODWORTH.

System and Discipline in the Shop.

Editor American Machinist:

After reading the second and third letters from "Dutch" at pages 1315 and 1520, I think he does not properly appreciate the efforts of those who responded with advice about his difficulty.

His first letter was a confession that after much effort he had failed to get his employees to properly care for tools and return them to their places, yet in his second letter he says: "I hope there won't be anyone foolish enough to think that because a man is not too self-conceited to value the opinion of others he is not capable of managing a shop."

If he knew so well how to manage a shop, he should have told us that and restricted his inquiry exclusively to the question of how to cure men of their careless habits. He says: "I could not, and cannot now, induce myself to believe that a shop with twenty-four men, and these men doing what could reasonably be expected of them, needs a toolroom."

He thinks there may be some scheme, if he could only find it, that would *"make men orderly"* without a particular selection of the men or without discharging any. He is simply the victim of a delusion. Millions of dollars have been wasted by able and intelligent men who made a life study of the problem of reforming various habits of men, and the results have been utterly insignificant when compared with the force expended. Where there has been any success at such efforts, it has resulted only from making this the sole business; anything else that was accomplished at the same time being merely incidental. The army and navy are the best examples of what can be done in human discipline. Except in time of actual war, about the only thing done is to train the men to a certain set of habits, and this is done by officers experienced in the business who have almost unlimited authority to enforce the rules. Also, to a certain extent, the men are selected for the duty and are better than the average in some ways. In fact, everything possible is done to *"make men orderly,"* yet, in spite of all this, some men soil and wear out their uniforms more than others, neglect and damage their arms and do various other things for which they have to be punished, and sometimes it is even necessary to discharge a man on account of extreme carelessness.

If such is the case where the chief business is discipline, not profit, what chance of success is there in a shop where profit is the main thing, and discipline must of necessity be subordinate to that?

All the men in the shop might be made orderly, but it can only be done by first making a careful selection of the men, and next by discharging all those who prove to be disorderly. If a proprietor cares more for a neat, orderly shop than he does for profits, there is no reason why he cannot have it, as long as his money lasts. It is opposed to natural laws to suppose that men can be made orderly by merely telling them to be orderly or having it understood in some other way. All people would be careless if there were no ill consequences to them from being so. It is utterly futile to try to make men return the tools to their places if they know that there is no penalty of any sort if they do not, nor any reward if they do.

Even if the majority of the men in such a shop are inclined to be orderly, there is no encouragement to continue so because, though they may always return tools to

their places, there is no assurance that they will find them there when wanted again. Men are careful and orderly because they find it saves energy to be so, but when the actions of others defeat this there is a constant influence toward making all equally careless.

As I stated before, the adoption of a toolroom does not cure the men of carelessness, but the check system tells who got the tool, and it can be located when called for. It also tells very quickly who the careless men are, and makes it possible to apply a penalty if desired.

The adoption of the toolroom makes it possible to employ careless men to the best advantage without their carelessness interfering greatly with the operations of the more careful. The success of this depends wholly upon the principle of making it the particular business of the tool department to keep tab on the tools and keep them in working order. The check system is not actually essential to this, except on a large scale, but it is a substitute for memory and enables more than one person to care for the tools.

In the ultimate sense there is no choice about having a toolroom. The time is coming when it will be just as much a necessity to the shop as lathes or planers are. In fact, it is so now, but many proprietors are ignorant of it. Some of them have a sort of feeling that there is something lacking about their shops which makes all work done in them too costly, but they don't know what is the matter. "Dutch" had an idea that a toolroom would be of some possible advantage, but he was yet without one, and it took the advice of the contributors to the AMERICAN MACHINIST to spur him on to the point of having it; for which he ought to be heartily thankful.

It is pertinent to remark that his is a good example of the ability it requires to ask for exactly what you want. He asked for certain information and your contributors did the best they could to answer him, but they gave him much he did not want, because his question was not complete and explicit enough. The particular answer he wanted he failed to get.

Truly it is a great art to specifically and completely ask for the desired information and it seems to be almost as difficult to do as to give a proper answer.

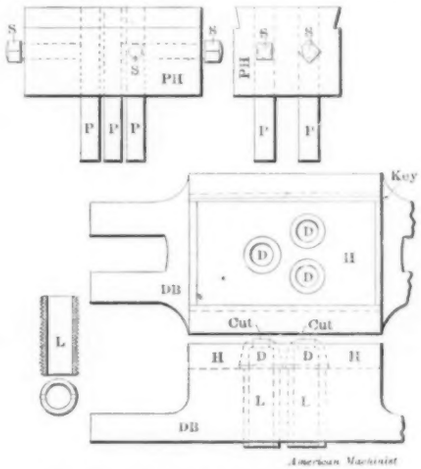
BELL CRANK.

Die Making—Gang or Multiple Blanking Tools.

Editor American Machinist:

In going from one shop to another and examining different methods of die-making I am constantly impressed with the old adage that "most things are new to somebody, while few things are new to everybody." Quite often we toolmakers say that certain existing methods of die-making have some virtues and possibly may do in special cases, but we deny that they can ever come into general use. Of course we are all so very wise, especially those of us who have worked in the shop for many years, that we assume authority to ignore what we call "new fangled ideas." No doubt many earnest readers of the AMERICAN MACHINIST have been impressed lately by the variety of illustrated contributions on punches and dies. I presume that most of us have gained some knowledge by the presentation of this almost exhaustless theme.

Perhaps some of the most interesting methods of die-making are to be found in metal-button manufacturing concerns. Several years ago we had a large order for a cheap metal button, and in manufacturing these buttons we had a great many blanks to cut from sheet steel. These blanks were called "fillers," or, in other words, they were used to fill up the spaces between the fronts and backs of the buttons as they were assembled in a foot press. I send you a sketch of the tools we made to cut the blanks, which may be



MULTIPLE DIE FOR BUTTON BLANKS.

of interest to some of our die-maker friends.

The cast-iron holder *P H* carries the three blanking punches *P* held by the set-screws *S*. The views of the cast-iron die bed *D B* illustrate the method of holding the inserted blanking dies *D* by means of the die-holder plate *H* (machinery steel), which is keyed into the die-bed *D B* by a tapered key. *L L L'* represent the locating screws which hold the dies *D D D* in place from the base of the die-bed *D B*. The blanks, after being cut, pass through the dies *D* and the locating screws *L* into a box. A sectional view of one of the locating screws is given. Both the dies and punches are made from first quality tool steel (we prefer Styrian). The punches are hardened and tempered; the dies are hardened, tempered and ground.

In making the dies we "crown" them on the top, which makes it much easier to grind them when they get dull. We locate the three dies in *H* so as to obtain the most number of blanks from the given strip of metal which leaves only a little waste or scrap. The bottom or bearing surfaces of the inserted dies must be ground true after hardening. Our open-back, single-acting blanking presses are equipped with an automatic multiple pawl ratchet feed, by which device a small fractional part can be added or subtracted from its length of feed. The several pawls are disengaged simultaneously by a lever connected with this useful attachment.

MATTATUCK.

By the Help of the Foreman.

Editor American Machinist:

Your big birthday number was read with interest. Those anniversary occasions, such as the one thereby commemorated, give us good points of vantage from which to note the evidences of our progress, and it is quite a marvelous tale that you tell of constant improvement in the ways of doing things, in the perfection of our product and in the quantity of work turned out. You had quite a time of it in enumerating the multifarious agencies that have co-operated to produce the grand total. Your errors, as might have been expected, were more after all of omission than of commission. I was hoping that you would not forget in your story the arduous and thankless, but very necessary, work of the shop foreman, but that is just what you did, and this is for a reminder.

I am afraid there is not much progress or improvement to be noted in the average shop foreman himself. I am not claiming for him here any honorable mention for what he now is as compared with what he was, but rather for what he has enabled or helped others to do for the general advancement. He has been, and he always is, too busy in shoving or guiding things in general to help himself along very much, and he remains the faithful, untiring and lightly appreciated servant of all. Things have gone along so swimmingly all these years, so much work has been done and so well done, our ways of doing things have so advanced and our speed of production has so increased for no reason more potent and patent than that the foremen in the different shops have been doing their work so thoroughly and so untiringly. As the foreman in any shop is immediately missed if he is absent for an hour, and things begin to have a different hum at once, so the tune to be sung at our quarter-century festival would have been a very different one but for the constant and active presence of the foremen.

The duties and responsibilities of the shop foremen have increased greatly with the development of the trade. There are more things to be looked after, and to be looked after sharper, although it may be conceded that some of them are different in kind. Besides a more numerous and intricate detail of supplies at the beginning and a more exacting precision and correspondence to standards at the other end, the routine between is more elaborated and provides more frequent opportu-

nities for errors if not all maintained in synchronism. It may not have occurred to everyone that besides the education of the apprentices in the shop, or of those avowedly "learning the trade," there must always be maintained, whether consciously or not, a system of education for the established hands of the shop as well. Even if they may not be expected to improve beyond a certain recognized standard, it is still no little task to hold them constantly up to that standard by criticism and suggestion and to keep them all well disposed and effective. The foreman's duties and responsibilities have increased and no automatic or labor-saving contrivances have come in to help him. He has to do his work unaided, and day by day he is usually so used up by his labors as to leave little surplus energy for the promotion of the usual side schemes of betterment which many other mechanics are in the habit of working.

There are some curious things that have puzzled me more than a little about the recognized position—better say unrecognized—of the foreman in the up-to-date shop. I have no hesitation in saying that, as a general thing, for the hard and responsible work of the foreman who is all right, and for the results dependent upon his faithfulness and efficiency, results which generally are not missing, he is not paid enough in comparison with what others are paid. Then I am in a quandary at once. I don't know whether it is that the foreman is not paid according to his actual deserts because he is not adequately appreciated, or whether he is not appreciated because we do not pay him enough. I have rather come to the conclusion that there is another reason independent of this dilemma, and that is that he is not open to the free competition of the labor market as is the ordinary workman. The journeyman can go from shop to shop as the fit takes him, and if a man is wanted anywhere he is pretty sure of getting a job and at the prevailing rate of wages, and the prevailing rate of wages will vary more or less according to the times, and he will get on the average and for all the year round about what men in other trades get with whom it is fair to compare him. If he shows himself pronouncedly better than others as a workman, he is pretty sure also of getting better wages.

Now the foreman's position is something entirely different. When he happens to fit he is almost necessarily a fixture. You can't afford to change foremen very often because they have to know so much, not only about the trade in general, but about the ways, traditions, facilities, expectations and many other things concerned with the running of the individual shop. He must know how to handle the proprietor on the one side and the workman on the other, and must have the faculty of lubricating the human machine and making it run, not only smoothly, but also up to speed under a full cut. As the proprietors all know that it does not pay to change foremen often, and as such changes are comparatively infrequent, when a foreman does get out of a job, no matter how good a man he may be he is apt to stay out for a while. There are often no positions open that he can hear of or only a few widely distributed over the country, or the shops may have special and different lines of work to which he is not accustomed, so he is never in a position to make a sharp bargain for his services, but is generally compelled to accept pretty near what is offered, and we all know that salaries are not apt to rise very rapidly on shop proprietors' offerings. This peculiar position of the foreman may be allowed to help to account for the fact that while with the lapse of time his position has become more important and responsible, while he is required by the circumstances of the times to know more and deeper of the mysteries of practical production, he is not accordingly increasingly recompensed. As the thing stands, the pecuniary outlook is not of the best for the shop foreman. He has always the alternative of getting out of the trade, and whenever he does he is not apt to be a loser, although the trade may be.

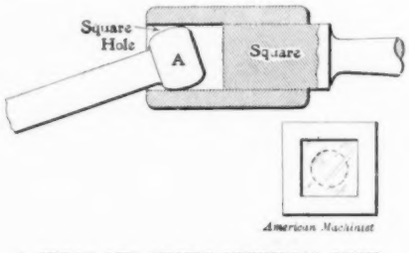
I suppose I have said enough about this. I am not in the foreman business myself and have no personal interest in the matter except as I like to see every fellow get what he ought to get, and in our self-gratulation over the all-around advance I would like to have it so fixed that the shop foreman may feel warranted in participating in it with all the rest.

TECUMSEH SWIFT.

A Simple Universal Joint.

Editor American Machinist:

We required a universal joint at short notice for an experimental machine. The sketch, sufficiently clear without further



A CHEAP AND SIMPLE UNIVERSAL JOINT.

elaboration, shows how it was made. The end *A* was made a rather shaky fit. No machine work was done on it—simply filed up.

COSMOPOLITAN.

A Draftsman's Temptation.

Editor American Machinist:

A word on Mr. C. E. Coolidge's contribution at page 874 on "Average Drawing Room Practice." Mechanical drawing is a grand study and profession for a young man who has a liking for it, but how few young men while at college, studying in a large, airy classroom, with everything to make study a pleasure, give the practical side of drawing a thought? Let me give a little of my experience of what is every-day work for a draftsman: About eighteen months ago I was called on to make a drawing for some changes in a boiler-room, part of which was already erected. The old steam plant consisted of two batteries of boilers located in an old building with very low roof. By the side of these boilers another battery was placed and almost completed, when the superintendent changed the plans and added two new batteries instead of one, and in the change part of a factory building had to be removed. The drawing wanted was for the main steam "header." The new boilers were not under cover and the weather was about 18 below zero. The old ones were under cover, and a *close one at that.* To get any data and measures I was obliged to go back and forth from heat to cold, and I suffered from both so much that I guessed at a number of the measures.

The work of putting in the header was to be done by contract. *Here is where I was up against the real thing.* The contractor looked the job over and then over my drawing. The superintendent wished to hold the contractor responsible for the work, but he would not guarantee beyond what the drawing called for. The outcome of the whole thing was that I was obliged to go all over the work again.

I relate this experience to show that, while I knew how to get the data and make the drawing, I was tempted, *owing to existing difficulties,* to take a few chances and slight my work.

To the student: Do not get careless after leaving "Drawing Room Practice." Even if drawings are made under difficulties, unless made correct better not make at all.

MACHINIST.

Recklessness of Workmen.

Editor American Machinist:

Whenever I read or hear of a workman who, through some careless act of his own, has been injured in the machine shop, I cannot help recalling the reckless, yes foolhardy, habits of certain of the employees in a cartridge shop where I worked when a boy. And when I consider some of the risks which those men often deliberately ran, what little hair I have left upon my head is apt to rise, and I find myself wondering that so few people were seriously injured in that shop.

It was not a large place—perhaps the entire force included not more than sixty hands—and was located in a small country town. Although some of the materials dealt with were of a very dangerous character, the discipline in the shop was not very severe; there were few rules and regulations to be rigidly observed, and no

notices were posted about the place warning workmen against certain moves which would be likely to get them into trouble of a painful nature. In fact, the shop was operated on the whole, in much the same manner as any ordinary factory would be run in a little town where everyone knows everyone else intimately, and where employers and employees are more or less closely associated in all local affairs.

This was before the day of smokeless powder, and all cartridges were loaded with black powder, this being brought from the mills many miles away in four-horse wagons and stored in a brick magazine near the shop.

Both rim and center fire cartridges were made, the smaller sizes being loaded under hand presses and the rest in semi-automatic machines. In loading ball cartridges on these machines two operators were employed, one placing the shells—which had of course been primed—on the table in front, from which they were carried by a dial under the powder charger; and the other placing the balls, or bullets, in a dial at the rear which carried them around over the shells and under a punch that forced each ball down into place in the charged shell below. It was in connection with this loading operation that we had the liveliest and most interesting experience.

The powder was brought in from a wood building near by (where only one keg of each grade was open at a time) in a covered box containing eight cans, each can holding one pound. The box was placed in a small pocket which was built out from the side of the loading room and closed with a sliding door at the front. The loading room was really an annex to the shop proper, and in size about 12x24 feet. Two machines were in this little building, and over each was a large canvas-covered frame so placed in the roof that in case of trouble below it would lift in a hurry and relieve the pressure.

The loader magazine was a cone-shaped affair, about 2 feet high, made of sheet steel and fitted in such a manner in the casting in which the charging dial rotated that the small opening at the bottom of the cone came directly over the hole in the charger. There was seldom more than one pound of powder in the magazine, but that was quite enough when for any reason it went out at the top instead of the bottom.

One pound of powder is a small quantity when compared with the hundreds of pounds backing up the huge projectiles in some of our modern guns; but—did you ever sit in a small room, with your head within a foot and a half of a rather thin sheet-metal receptacle containing a pound of powder, when that powder exploded? It's an interesting experience, I can assure you. I've been there. There's a snap and a flash as a primer is caught under the shell dial or exploded by the pressure of one of the punches; a line of flame leaps quicker than thought across that dial to the powder chamber and then there's a deafening report and for a few seconds everything seems to be badly mixed. After realizing that you are not in the chair where you should be, you pick yourself up from the floor (where in some sudden and unaccountable manner you have been more or less gently dropped) and finding that neither yourself nor your fellow-operator has been seriously injured you begin to wonder how long it will take to repair the machine, get the roof sewed together (for it has separated along the entire ridge), replace some of the windows, and repair the door which has left its hinges and now rests on the floor and presents a somewhat battered appearance. You wish to know when these things will be put right for you are running piece-work and time is money. The other employees in the shop, after looking you over and viewing the wreckage about the room, go back to work; a "blow up" on the loader has occurred before and therefore causes no great excitement. Well—after a little the machine is again in commission and running along as before.

With this and other equally striking examples of the force of gunpowder brought to their attention, one would think that workmen in such a shop would be the most careful of people. Such, however, was not always the case, and it was of some of the thoughtless performances at that place that I was thinking when I started this letter.

I went out one morning, when employed on the loader, to fill my powder cans in the building where, as already mentioned, we always had open one keg of each grade of powder. A man out there sat straddle of a plank, which rested upon two kegs, pulling balls out of old cartridges that had been returned from the store which handled the goods; it being customary to remove the bullets from all such cartridges and run them over again, the shells being turned into brass or copper scrap. As I stood over a keg—from which the head had been removed and in which was about 25 pounds of powder—engaged in scooping up the stuff and filling my powder cans, I heard a sharp crack directly behind me, and without looking around to investigate, made rapid time out of the building. I heard laughter as I struck the road, otherwise I might, perhaps, be running yet, and upon returning to the powder-house found that that bullet extractor, thinking he would have a little fun at my expense, had placed a primer on the iron strip under which he slipped the heads of the shells while drawing the bullets, and exploded it with a blow of his pincers. He sat with a keg of powder—wide open, understand—at either side of him, and with loose powder lying on his board and about the floor deliberately exploded that primer. Why some of the loose grains of powder were not ignited, and, through these and the loose powder about the place forming a trail to the kegs, the powder in the latter touched off, I do not understand. Anyone who has ever observed the ease and rapidity with which a flash of fire passes along over a powder-sprinkled surface will appreciate the situation thoroughly. It must have been our lucky day; that both of us were not blown to "Kingdom come" through this piece of folly was, I think, little short of miraculous. However, this is only one illustration of what a thoughtless fellow will do when looking for excitement.

The boys at the shop were in the habit of purchasing their ammunition for Fourth of July celebrations and hunting purposes, of the company. One of them started up the street one night with a canvas bag containing 5 or 6 pounds of powder under his arm. A fellow workman with a lighted cigar in his mouth approached and, engaging him in conversation, held the business end of his cigar so near the bag that we could almost smell scorched canvas. The proprietor of the powder did a quick side step and the rest of us moved up the street with considerable alacrity. The man with the cigar seemed to think he had a good joke on the crowd, but personally I never was able to see the joke. Such would-be jokers, I believe, should be cared for by the State, as they certainly are not fit to run at large among their fellow beings.

Not all experimenters with gunpowder and fire escaped as luckily as did those in the cases cited. A young fellow sat at work at his bench late one afternoon in the winter. For illumination he had an ordinary kerosene lamp, and on the lamp chimney was a pasteboard shade. This shade was improperly guarded and commenced to smoulder, then to blaze. Quickly removing the shade from the chimney he ran with it to a metal waste barrel—which was half filled with sweepings—and threw it in. He did not realize how much powder had accumulated in that dirt barrel—at least he did not stop to think about it—otherwise he would have thrown that shade into a pail of water and taken no chances. The instant that fiery piece of pasteboard struck the contents of the barrel there was a volcanic eruption. With eyebrows and the greater part of his hair missing, with face, hands and arms dreadfully burned and eyes so filled with dirt and powder that it was impossible to tell whether his sight had been badly injured, the young man was taken to the nearest drug store, there swathed in cotton and sweet oil, and then carried home to await medical attendance. After several long and dreary weeks he went back to work in as good condition as before. And he was, perhaps it is unnecessary to state, a wiser and more careful employee than he had previously been.

S. F. Arthur.

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Modification of the English Patent Law.

We have received from Mr. W. Lloyd Wise, of London, a copy of a paper read by him before the Society of Chemical Industry of Great Britain on Preliminary Examination of Applications for Patents, which outlines a patent law scheme which has been incorporated in a bill now before the British Parliament, it having passed the preliminary committee stage and its passage being considered assured.

As our readers are aware, the practice in England is to issue a patent to whomsoever may ask for it, and without regard to novelty. In case of lack of novelty such a patent amounts to nothing, but the idea of the English law is that the applicant shall assume the task of determining if his invention is really novel before applying for a patent, the courts being relied upon to settle the matter in case of dispute.

The objection which the Englishman has to our method is that by the act of the examiner an inventor may be denied a patent to which he is justly entitled. Of course in our case the applicant may appeal to the examiner-in-chief of the division and ultimately to the Commissioner of Patents, but the English idea is that the appeal should be to the courts which their present system insures. The practice in Germany is similar to our own, except that the lines are there drawn much more closely, as every American applicant for a German patent knows. Of course, as an example, Germany stands on as good a footing as we do, and Mr. Wise quite properly refers to some cases in Germany in which the methods followed have led to flagrant injustice, these cases being the epoch-making inventions of the Bessemer process and the Siemens regenerative furnace. It has, in fact, been stated by Sir C. W. Siemens that, as a rule, patents are granted in Germany for small mechanical improvements, but very rarely for an invention embodying any new application of any physical principle.

The general scheme of the proposed new British patent law recognizes the fact that the inventor should be saved the expense of a search which the government can make, not only much more cheaply, but much more effectively than is possible by an inventor through his attorneys, but it also protects the inventor from possible injustice by the Patent Office by denying to the latter the right to refuse patents. Under this system the inventor will be notified of the result of the search and is expected to amend his specifications and claims in accordance therewith, which he will naturally do if he considers the citations to be sound. Should he, however, differ from the Patent Office he may have his patent granted as originally drawn or he may amend in accordance with some of the citations and refuse to consider others, leaving the matter for final determination by the courts, as at present.

There can be no doubt that the right to refuse a patent by the Office does, in Germany, sometimes result in hardship, and the same may be true here, though we have never known a case. It is a matter of the practice of the Office rather than of the formal procedure prescribed. In Germany the idea seems to be to consider the patent a grant of public favor, and the aim is to make the grant as small as possible. Here the patent is looked upon as a just title to property. There the presumption is against the inventor, while here it is in his favor.

Who Will Build the Engineers' House?

Magnificent engineering co-operation it was that so easily, apparently, raised the fund for the John Fritz medal and made such a success of the John Fritz dinner. We commend to the attention of our readers the following suggestion in connection therewith from the editorial page of the *Electrical World and Engineer:*

"This Fritz medal, so worthily bestowed, ought to be regarded as a bond and pledge of work in other directions. We might mention one, namely, the securing of a commodious engineering building in this city, to accommodate the headquarters of the various societies of an engineering and scientific character, and to house also the Engineers' Club, which has long been the hearth and social rallying point of all such institutions. There need be no surrendering of autonomy by any society; there need be nothing eleemosynary about the plan; but it does seem to us that this is a cause which should appeal for financial support to the superabundant wealth placed by the skill and labor of engineers in generous hands. The American Institute of Electrical Engineers is very badly in need of a home for itself and its matchless select library, and we sometimes wonder there is not a rush of electrical millionaires to fill the want and to cover themselves with praise and glory. We have despaired long time of the joint engineering building, but make bold to say that the man who meets these pressing necessities will do more for the arts and sciences than if he added another to the already redundant colleges and universities."

Our neighbor need not despair, no one need despair. We certainly do not. We regard a magnificent engineering building, splendidly adapted to the needs of the great national societies and not unworthy of the metropolis of the New World, as among the inevitables, and we are sure that the longer it is delayed the greater will be the success of it. It is to our thinking impossible that some man of embarrassing wealth, of wealth which the engineers have made for him, will not see here the opportunity for at once doing a noble work and securing the perpetuation of his name. There would not be the slightest suggestion of humiliation to the engineers of America in the acceptance of a munificent sum for the erection of the

home that they need. The engineers are largely the makers of wealth for others than themselves, and the house we are thinking of would largely be for the use of those who have not yet made their life successes and for those many faithful workers to whom more than a competence may never be expected to come. With Columbia University asking for ten million dollars at once—or isn't it fifteen millions?—with the great begging arch of the cathedral standing imploringly on the heights, with the many not unworthy institutions not only in the great city but throughout the land receiving constantly such princely endowments, it is really a little thing that the engineers can ask.

When a job comes along that must be done we are not usually deterred from doing anything by the fact that we do not see clearly and fully at the first the way to do the whole of it. The true way and the usual way is to go to work and to do what we can, and as we go along the way opens before us, usually clear to the end. The trouble with the matter before us is that up to the present time we have not begun to consider it according to engineering methods. We have not made a move because the money for the work has not been in sight. That is not the usual way of the engineer, especially of the great engineer, who should be interested here if anywhere. Let us, when we are really ready, go at it in an engineering way. Let us discuss plans and prepare designs, and let no one whose ideas are small have anything to do with it. When we have the plans all settled and the costs figured out and the attractive designs all ready for exhibition, then will be time enough to look around to see who will help us to build it.

Our attention is specially called to this matter at the present time by the annual meeting of the American Society of Mechanical Engineers. Although they have a house which is suitable enough for some of the functions of the society, it is pitifully inadequate for the accommodation of the membership at the meetings, so that it has been imperative to use a larger hall in the neighborhood. This, we all know, certainly ought not to be, and the inconvenience may spur to necessary action. The John Fritz dinner as a beginning in co-operation was such a success that, as our neighbor suggests, a further working together may be hoped for with equally happy results.

The Metric System and European Trade.

Editor American Machinist:

I have carefully followed the valuable articles appearing in your paper in regard to the bill that the United States Government proposes for the adoption of the metric system in your country. I think that I have some experience with the sale of American tools in Europe, and believe that American tool manufacturers are quite wrong in systematically resisting the proposed bill as far as their European trade is concerned. Their German competitors will probably make a demonstration of this opinion.

The second resolution of the Cleveland convention of the National Machine Tool Builders' Association reproduced at page 1525 of your paper is somewhat puerile. The machines referred to were accepted by customers with only the adjusting and measuring screws made metric because at that time, namely, two or three years ago, the demand was very active and the buyers accepted what the manufacturer was willing to give him, but conditions have changed a great deal in Europe and a large number of tool users now buy German tools, while they used to buy American tools simply because the former are manufactured thoroughly to the metric system.

There is no doubt that the metric system will be exclusively used the world over some day, even in the United States, and it would seem to me that since the American, tool manufacturers will have to make the change from the English system to the metric, it would not cost them any more now than later, and of course the sooner will be the better for them, as when their European trade is lost and in the hands of their German competitors it is doubtful that it will be easy to secure it again. MACHINE TOOL SALESMAN.

Paris, France.

Action of the Cincinnati Manufacturers on the Metric System.

The Franklin Institute Committee on the Metric System has, as many of our readers are aware, circulated a list of questions among the manufacturers of the country. The manufacturers of Cincinnati have taken concerted action in replying to these questions, and as their answers give the views of a large and important manufacturing section we consider it only proper that they be given in our columns. The questions and answers are sandwiched together below:

1. Is it not desirable to simplify and change the system of weights and measures at present in general use in this country?

A.—It is desirable to simplify the present system if it can be done without introducing more confusion than is saved, which we doubt. It is not desirable to change the system.

2. In view of the fact that the following countries officially and customarily employ the metric system of weights and measures—namely, France, Germany, Austro-Hungary, Norway and Sweden, Grand Duchy of Finland, Holland, Belgium, Switzerland, Spain, Portugal, Italy, Servia, Roumania, Bulgaria, Greece, the Ottoman Empire, Japan, China (thirty-eight ports), Egypt, Mexico, the Central American and South American countries, the dependencies of the above-mentioned countries and the Latin acquisitions of the United States—do you not consider that it would be advisable to adopt the metric system in the United States with the view of bringing about international uniformity in weights and measures?

A.—The statement that the countries named "customarily employ the metric system" is a pure assumption. No evidence of this is submitted, while on the contrary, all available evidence shows that in some of these countries the system is used but little, and in none of them is it universal. Even in France the old units are still in wide use. Considering the age of the system, this is sufficient proof that it cannot become universal, and all arguments based on the assumption that it can be fall to the ground.

3. Would not the introduction of the metric system benefit the foreign trade of the United States?

A.—Of the millions of dollars of machine tools which the members of the Association have sold to France and Germany, the great majority have been sold without request or suggestion that any of the dimensions be made in accordance with the metric system. The only changes that have been asked for have been in occasional measuring and adjusting screws. In view of this experience and of the unexampled growth of the export trade of this country during the past half-dozen years we cannot see any need of changing for the benefit of foreign trade.

4 Do you not consider that the introduction of the metric system would facilitate and abbreviate the computations which present themselves in the ordinary occupations of life?

A.—Theoretically yes, though to an extent that has been grossly exaggerated. The supposed gain, considered in its economic value to the nation, we consider to be trifling. Moreover, this trifling gain is dependent upon the old units becoming extinct, which in France and Germany they have not done. On the other hand, the existence of both old and new units in those countries serves in many instances to *increase* the labor of calculations and to nullify the whole argument based on the theory of the metric system.

5. Would not the introduction of the metric system, by practically limiting the units of weights and measures to (1) the meter, (2) the gram, (3) the liter and (4) the are; and in view of the simple prefix system of decimal multiples and submultiples existing in that system, assist in measuring and expressing quantitative values of all kinds?

A.—Should the old units become extinct, yes; but the experience of metric-using countries shows that they will not. The adoption of the system will thus *add* to the number of units to be learned.

6. It has been found upon investigation by the Bureau of Education of the United States and the Select Committee on Weights and Measures of the House of Commons of Great Britain that a year of

the school life of children could be saved through replacing the customary weights and measures by the metric system. In view of this fact, is not the change to be desired from an educational standpoint?

A.—This conclusion is also based on the theory that the old units will become extinct. If the old units are to continue, as all experience shows they will, the conclusion is nullified and reversed—the children will have an additional system to learn and their labors will be *increased*, not diminished.

7. What length of time do you think would be required to instruct artisans in the use of the metric system?

A.—The experience of France has shown that the change cannot be completed in a century. In view of this, we regard what anyone "thinks" about the matter as of no importance.

8. Would the fact that in the decimal system continued fractional subdivision by 2 cannot be conveniently carried so far as in the customary weights and measures with common fractions seriously militate against the introduction or use of the metric system?

A.—We consider the advantage of the binary system of division to be too important to be dispensed with.

9. If the metric system were adopted within a few years in your business, would its gradual adoption entail great expense? How could this expense be minimized or avoided?

A.—To adopt the system gradually would involve making machines for years with part English and part metric dimensions, with constant change as the English dimensions are dropped—that is, until the transition is complete. During this period there could be no standardized production, but constant change. We cannot regard the use of both systems on the same machine as a thing to be tolerated, much less deliberately encouraged. To continue existing units on old machines while adopting the metric units on new ones helps matters but little, as in all lines of machines many parts are common to different sizes. Moreover, the whole question is based on the idea that the sacrifice of the change is measured by the cost of buying new small tools. On the contrary, the chief sacrifice is in the changing of standardized things—in the throwing away of standards, the value of which we will not know until we lose them. The value of shafting and pulley standards, for example, lies in the fact that by reason of them shafting and pulleys may be made in large quantities and therefore cheaply; that because their fitting is insured, they can be made in advance and sold from stock as needed, instead of being made to order at increased cost and delay; that pulleys can be changed about as needed, and if thrown out of use become again available for any shaft of their size, whenever wanted. Who would think of estimating the value of shafting standards to the country, by the value of the turning and boring tools and gages in pulley and shafting factories? Nevertheless, that is exactly what you do when you tacitly assume that the cost of changing our shop standards is measured by the expense of new tools. Imagine, if you can, the confusion that would prevail if pulleys and shafting had never been standardized, and you will begin to understand how ridiculous is your assumption that the cost of this change can be measured by the cost of small tools. Into the loss due to the destruction of standards the element of time does not enter, and we therefore regard the idea of a gradual change as simply postponing and refusing to face the difficulties of the problem.

10. Are you in favor of the bill, H. R., 123, as reported from the Committee on Coinage, Weights and Measures, and which it is expected will be considered at the coming session of Congress, and which reads as follows? "A bill to adopt the weights and measures of the metric system as the standard weights and measures in the United States. (1) Be it enacted by the Senate and House of Representatives of the United States of America, in Congress assembled, (2) that on and after the first day of January, 1904, all the departments of the Government of the United States, in the transaction of all business requiring the use of weights and measurement, except in completing survey of public lands, shall employ and use only the weights and measures of the metric system; and on and after the first day of January, 1907, the weights and measures of the metric system shall be legal standard weights and measures of and in the United States."

A.—No. We believe that the difficulties of the change have been ridiculously underestimated, and that the metric system offers no compensating advantages. We regard the whole matter as a shop affair exclusively, since the confusion and expense must be borne by the shops. We therefore regard the intrusion of those who have no pecuniary interest in shops, as unwarranted.

These answers were signed by the following firms of the Cincinnati district: American Fire Engine Company, Belmer Machine Tool Company, Cincinnati Machine Tool Company, Cincinnati Milling Machine Company, Cincinnati Planer Company, Cincinnati Shaper Company, Dreses Machine Tool Company, J. H. Day Company, Wm. E. Gang Company; Greaves, Klusman & Co.; Laidlaw-Dunn-Gordon Company, Lane & Bodley Company, J. M. Robinson & Co., Sebastian Lathe Company, Schumacher & Boye, John Steptoe & Co., Smith & Mills, Triumph Electric & Ice Machine Company, Cincinnati Punch & Shear Company, Bradford Machine Tool Company, American Tool Works Company, Jos. S. Blettner & Co., Barker & Chard Machine Tool Company, Dietz Machine Tool Company, Fosdick & Holloway Machine Tool Company, I. & E. Greenwald Drill & Tool Company, R. K. Greenwald & Co., Bickford Drill & Tool Company, R. K. LeBlond Machine Tool Company, Springfield Machine Tool Company, and others whose names we have not been able to get.

Machine Tool Progress of Cincinnati During the Past Twenty-five Years.

Nothing is so difficult as the collection of figures and statistics, especially when the work is done hastily. The original scheme of our anniversary number contemplated the recording of the machine-tool progress of the period covered during our lifetime as a periodical, but it occurred to us at a late date that this, if strictly adhered to, would omit the most striking feature of that progress—the development of Cincinnati as a machine-tool building center, since Cincinnati was not such a center at the beginning of the period covered. To remedy this we prepared, somewhat hastily, the article which appeared at page 1622. We now find several unpardonable omissions from the list of names and hence do the best we can by supplying the omissions here. The names omitted were: The Cincinnati Punch and Shear Company, Knecht Bros. Company, McCrosky & Huber, The National Machine Tool Company, Schumacher & Boye, and The Shepard Lathe Company.

Program of Mechanical Engineers' Meeting.

The following are the essential particulars from the official program for the coming meeting in this city of the American Society of Mechanical Engineers:

The convention will begin on Tuesday evening, December 2, at the society's house, 12 West Thirty-first street, at 8.30 P. M., with a discussion of the paper by Prof. Sidney A. Reeves, entitled "A Rational Solution of the Problem of Weights and Measures." The first evening session has usually been given up to an address by the retiring president, but this was impossible this year on account of the indisposition of Mr. Edwin H. Reynolds.

On account of the inadequate accommodations of the society house, the sessions of Wednesday morning and evening and that of Thursday morning will be held in the banquet room of the Sturtevant House, entrance on Twenty-ninth street, near Broadway. Luncheon will be served in the hotel on both those days. The annual reception will occur at Sherry's, Forty-fourth street and Fifth avenue, on Thursday evening, and the concluding session will be at the society house on Friday morning.

The annual business session will occur on Wednesday morning, and it promises to be one of unusual interest and importance. Action will be taken upon proposed amendments to the rules and other matters vitally affecting the future of the society.

The following is the order in which the papers are to be presented:

WEDNESDAY MORNING.

Halsey, F. A.—"The Metric System."

Reeve, S. A.—"Entropy Analysis of the Otto Cycle."

An afternoon session for the continuance of the discussion of Mr. Halsey's paper is likely to be necessary and has been provided for.

WEDNESDAY EVENING.

Riley, J. C.—"Apparatus for Obtaining a Continuous Record of the Position of an Engine Governor."

Slichter, W. I.—"Flywheel Capacity for Engine-Driven Alternators."

Kent, Wm.—"Heat Resistance the Reciprocal of Heat Conductivity."

Topical Discussions—Smoke Consumption, Elastic Resistance, Oil Burners, Oil Separation from Steam, Oil Tempering of Steel.

THURSDAY MORNING.

Barnay, J. M.—"A Forty-four-Foot Pit Lathe."

Porter, Charles T.—"Finer Screw Threads."

Tyler, C. C.—"A Surveying Instrument in the Machine Shop."

Richards, Frank—"Gift Propositions for Paying Workmen."

Trinks, W.—"Deflections of Beams by Graphics."

FRIDAY MORNING.

Wilkin, J. T.—"Rotary Pumps."

Lane, H. M.—"Filing System for Office Use."

Nagle, A. F.—"Analysis of Commercial Value of Water Power, per Horse-Power per Annum."

Viola, B.—"Centrifugal Machines."

Kingsbury, A.—"Oil-Testing Machine and Results."

Concluding business. Adjournment.

Obituary.

John A. Grier, a manufacturer of reapers, died in Chicago, November 12. He served as an engineer in the navy during the Civil War and was for many years chief engineer of the United States Mint at Philadelphia.

Philo H. Skidmore, Jr., proprietor of the Pacific Iron Works, Bridgeport, Conn., died November 9, fifty-one years old. The works were started by Mr. Skidmore's father, and the son first took a position there in 1874, in 1884 becoming sole proprietor.

Col. Thomas J. Borden, prominent in the textile industries of Massachusetts, died November 21, seventy years old. Mr. Borden began his business career in the Fall River Iron Works, of which his father was treasurer. He subsequently held positions of high authority in several large mills, and in 1871 he organized the Richard Borden Company.

Friedrich Alfred Krupp, the head of the world's greatest gun works and the richest man in Germany, died of apoplexy at Essen, November 22. He was the third successive head of the works, surviving his father but fifteen years, but long enough to have proved himself in ability and enterprise a not unworthy successor. Our readers have no need now to be informed of the greatness of the establishment or the high standard of its methods. It had grown and advanced under its latest head as rapidly and as safely as at any preceding period, and it was never greater or higher in the world's estimation than to-day. Herr Krupp is understood to have deserved and commanded the respect and esteem of his workmen, and he was the originator of many schemes for their comfort and betterment.

Commercial Review.

NEW YORK, November 24, 1902.

Recently we observed that the machine-tool business showed a falling off in the volume of trade. While there was a disposition in some quarters to question the statement, we now find opinion pretty unanimous concerning it.

The writer, during the past week, took occasion to interview prominent machine-tool men for the purpose of obtaining their views on the subject. The remarkable feature of the explanations they offered was that experience for many years had shown, that between election day and the first of the new year, and more particularly as the Christmas holidays drew near, business always showed a tendency to slacken, and invariably did so. They said that the greatest contributing factor to this condition of affairs was that business men in every department of trade, generally devoted the two closing months of the year, and especially the last month, to going over their books for the year that was vanishing, first to ascertain whether or not their business had been profitable, and secondly to formulate plans for its improvement or revision, as the case may be, for the year that was shortly to be ushered in.

Those who argued along these lines contended that no surprise should be expressed now that business in the machine-tool industry has fallen off, saying that because of what they had stated, it was only natural for it to do so. Under the circumstances, they declared, too much importance should not be placed on recent developments, saying that they were valueless as regards giving any insight into what the future would bring forth.

From the comments made, the inference can be taken that machine-tool men expect business to be dull until the advent of the new year. In the meantime they believe that orders will not only be less numerous than they have been for several months past, but that more hustling than usual will have to be displayed by those who wish to capture such as will be given, which is only another way of saying that competition is likely to be a little more keen during the next few weeks than it has been for some time past.

"Between now and the first of January," said a machine-tool manufacturer, "even if orders are few and far between, we will find our time fully occupied, for I don't suppose there is a house in the trade that hasn't enough orders on its books to keep its working force busy until at least then. Should I be mistaken, I think that those who have not will get enough orders in the meantime to keep them going."

With the slight let-up in the trade in machine tools, some speculation is indulged in as to the effect, if any, it will have on prices. We have frequently noted the fact that since the formal advances of 10 per cent. were made in lathes, drills, shapers and planers in the early part of last summer, current sales have been remarkable for their strict adherence to them. We say remarkable, because at the time these advances were made, and as we have noted before, there was a tendency in some quarters to doubt their maintenance. At the same time it must be said that conditions for several months were favorable to their maintenance.

But now that these have changed, even though slightly, there is some gossip as to what will happen to the advances. In the first place our best advices are that the situation is not serious enough to warrant the consideration of such a thing, opinion strongly inclining to the belief that the lull which has overtaken the trade is going to have a transitory duration.

Prices in the machine-tool trade are too strongly intrenched to be affected by every ill-wind that blows. To begin with, some of the leading manufacturers of machine tools in the country are committed to these advances. Since they were made these manufacturers have made their prices conform with them, and we have yet to learn of a single valid reason capable of shaking their determination. In the next place, those who are not committed to the advances know that the increased cost of labor and material, in which there has been no retrogression, made them desirable, if not compulsory, and make them the basis of their sales. Other reasons suggest themselves as to why present prices will prevail, but the two we have mentioned are regarded as controlling.

While salesrooms of machinery houses have borne a barren appearance during the present year, in consequence of the great rush of business which has prevailed, we notice that many of them have had their equipment enlarged during the past few weeks. This is especially true of houses which represent several machine-tool interests. The salesroom of the Prentiss Tool & Supply Company, at 115 Liberty street, for example, has now a larger and finer collection of machine tools displayed than could be seen at any time during the present year. Manufacturers' salesrooms also show up better in this respect than they have for some time

past, notably the Niles-Bement-Pond Company, at 136 Liberty street. The list in both directions could be enlarged. The reason for it is that deliveries are a little better now than they have been, and another factor has been the let-up in trade, which we have recently noted.

At the offices of the American Bicycle Company, it is said that the reorganization of the company's affairs will probably be completed in a few weeks at the latest. While details of the proposed plan have not been made public, we understand that it is proposed to convert the $9,500,000 debenture bonds into preferred stock, and to levy an assessment on the present preferred and common stock.

It is said that since the company went into the hands of a receiver, a few months ago, an immense saving has been effected in all branches of its business, particularly in its selling department, where it is claimed a saving of $300,000 alone has been accomplished by the reduction in the number of factories making bicycles from 47 to 6, and by dispensing with a large number of sales agencies.

The committee on reorganization has come to the conclusion, so we are informed, that as long as no agreement with independent manufacturers as to the selling price of bicycles exists, the company's prosperity is seriously menaced, and is now bending its energies toward having an agreement of the kind made. Should the committee's efforts be successful, an advance in the price of bicycles over present prices will undoubtedly be made.

The final papers in the consolidation of the Sharon Steel Company, of Sharon, Pa., and the Union Steel Company, of Donora, Pa., have been signed. The new company will be known as the Union Steel Company, and will be capitalized at $50,000,000. Mr. A. W. Mellon will be president, John Stevenson, Jr., and W. H. Donner, vice-presidents, and Wm. Flinn, chairman of the Board of Directors. The other officers are not yet selected.

The property of the Sharon Steel Company consists of 400 acres of land, one blast furnace in operation and two under construction, twelve open-hearth furnaces in operation, blooming mills, tin plate works, sheet and tube works, wire, rod and nail factory, all in operation, besides limestone quarries, coal lands, coke ovens and coal property in the Connellsville region.

The Union Steel Company's works at Donora consists of large wire, rod and nail works in operation and in the course of erection, two blast furnaces, blooming mill and twelve open-hearth furnaces, located on the Monongahela River, with 3 miles of river frontage and over 200 acres of land for manufacturing purposes. The company owns large tracts of coal lands in the Connellsville region, and is also the owner of a site for a harbor on Lake Erie, where the Elk River flows into the lake, which site consists of over 2,000 acres of land.

The Wilmarth & Morman Company, of Grand Rapids, Mich., manufacturers of drill grinders, did a larger business during October than during any other month of the present year. Among the shops fitted out during that brief period are the following: With dry grinders—the Lumsden & Van Stone Company, Boston, Mass.; Kokomo Steel Wire Company, Kokomo, Ind.; Standard Pipe & Twine Company, New York; Pittsburgh, Shawmut & Northern Railroad Company, Perkinsville, N. Y.; Youngstown Iron & Sheet & Tube Company, Youngstown, Ohio; The Globe Machine & Stamping Company, Cleveland, Ohio; Magee Furnace Company, Chelsea, Mass.; Reeves Bros. Company, Alliance, Ohio; Enterprise Boiler Company, Youngstown, Ohio; Globe Foundry & Machine Works, Niles, Ohio; James H. Jerkins, Seattle, Wash. (two); Parsons, Rich & Co., Newton, Iowa; Spang & Co., Ltd., Butler, Pa.; Theo. F. Kalbfleisch, Glens Falls, N. Y. With wet grinders—Penn-American Plate Glass Company, Alexandria, Ind.; Pennsylvania Steel Company, Steelton, Pa.; Ridgway Machine & Tool Company, Ridgway, Pa.; Cochrane & Co., Lorain, Ohio; Fort Wayne Foundry & Machine Company, Fort Wayne, Ind.; New York, Ontario & Western Railroad Company, Middletown, N. Y.; St. Louis & San Francisco Railroad Company (two); James H. Perkins, Seattle, Wash.; Imperial Engine Company, Painted Post, N. Y.; Lidgerwood Manufacturing Company, Brooklyn, N. Y. In addition there were twelve machines shipped by the company to foreign countries and a number of machines to machinery jobbers. Included in the above were two large Style "G" "Whale" grinders, the only drill grinder made in the world for handling of drills as large as 5 inches.

The Brown-Cochran Company, of Lorain, Ohio, is at present erecting an entirely new machine shop, 60x170 feet, to be devoted exclusively to the manufacture of this company's gas engines, carbonic anhydride refrigerating machinery and duplex gas compressors. Equipment is composed of the very latest machine tools on the market, and is all contracted for, some of it being already on the ground. The shop will be completed about December 15, and will enable this company to take care of their great surplus of business to advantage.

Charles H. Besly & Co., of Chicago, Ill., inform us that, having had many inquiries for a machine with 18-inch disks somewhat cheaper in price than their regular No. 4 Gardner grinder, their Gardner grinder meets this demand. It has floor setting-up press, two only 18-inch spiral grooved steel disks, two tilting tables, large spindle bearings and improved countershaft. Full particulars, prices and descriptive matter will be mailed on application. Their new catalog of Gardner grinders and Besly hand grinders can be had on application.

The Chicago Pneumatic Tool Company report a very large increase in sales during the past few weeks, and all of their factories are working night and day. Especially is this the case in their air-compressor department and the compressor factory, at Franklin, Pa., is being pushed to its utmost capacity. Mr. J. W. Duntley, president, is still continuing his business trip on the continent, and his route is announced by cables continually being received by the Chicago office containing large orders for pneumatic tools, annealing machines, rivet forges, etc. His return is not definitely announced, although he will in all probability leave Europe in the very near future.

An interesting example of the application of induction motors to the driving of shop machinery is afforded by the plant of Wm. Demuth & Co., Brooklyn, N. Y. The original intention of the operators of the establishment was to make use of direct current from the distribution system of one of the Brooklyn power companies, but a polyphase alternating system was finally installed on account of its many attractive features. Power for the factory is furnished by two Westinghouse two-phase, compensated-field alternators, driven by Corliss and Ball & Wood engines having a close speed regulation. Excitation is furnished by small multipolar dynamos driven from the main generator shafts. The switchboard contains three panels for generators and feeders. The main power system operates at 220 volts, and all motors are wound for this pressure. Lighting is also supplied from the two-phase mains, special balancing transformers being introduced between the 220-volt leads for the purpose of furnishing a 110-volt, three-wire lighting service and equalizing unbalanced loads upon the lighting system. Motive power in the factory is furnished by fourteen Westinghouse type "C" induction motors, varying in capacity from 5 to 20 horse-power. The majority of these motors are mounted overhead upon wooden sleepers bolted to the beams of the floor above.

CHICAGO MACHINERY MARKET.

Pipe is lower, pig iron is believed to have reached the top, and deliveries of boilers and engines are a little earlier, particularly so of the smaller units. Output of the factories is a little greater, current demand may be slightly less. That is the way the market for power looks to many of the producers of medium sized units. One engine builder, who now confesses to a decrease in inquiry, explains it thus: "We have at intervals during the past three years largely increased the number of our orders, and the shops were thus sold so far ahead that they were put temporarily out of the market, business going to other makers who could deliver more promptly. Then, when a month or two elapsed with-

out any new orders, we had gained sufficiently on our orders to be brought back into line on deliveries and we again loaded up. Trade has been quiet with us for a month past, but by the end of another month, this dullness continuing, I think we will be in a position to take some business."

At bottom there is nothing the matter with trade, and the present comparative lull, which is by no means universal, is imputed largely to the waning year and to the disturbed financial situation during the past few weeks. It is too late for business to be closed for this year's shipment and too early for trades to be closed for forward 1903 shipment. But there seems to be an abundance of business in sight. One large seller of boilers says he is now figuring on a half dozen large contracts from absolutely new concerns, who are making all preliminary arrangements for construction work before giving any public hint of their intentions. There is also under negotiation much work from manufacturers, who have outgrown their present power plants and are arranging to have them displaced by others of higher efficiency. Expenditures for shop improvements are made with freedom, because of the generally prosperous condition of the manufacturers, and a demonstration of economy in making a change is speedily followed by executive action.

The Lake Erie Iron Works has sold to the American Can Company three 60-inch boilers of 250 horse-power and an engine of 150 horse-power for Cleveland (Ohio) delivery, and one 66-inch boiler and an engine of 150 horse-power each for Toledo delivery; also a 150 horse-power engine and boiler to the Standard Box Company, Baton Rouge, La., and two 100 horse-power boilers to the Muskogee Water Works, Muskogee, I. T.

Among recent orders of the Heine Safety Boiler Company are the following: One 425 horse-power to the Texarkana (Tex.) Gas & Electric Company; three 340 horse-power to the Merchants Light & Power Company, Montgomery, Ala.; one 200 horse-power to the Planters Oil Mill, Monroe, La.; one 255 horse-power to the Jennings (La.) Electric Light & Power Company; one 125 horse-power to the Otis Elevator Company, Chicago; two of 225 horse-power each, Houston, Tex.; one of 225 horse-power, Belleville, Ind., and three of 200 horse-power each to a new hospital at St. Louis.

Wickes Bros. have opened an office at Chicago for their machinery department. They report trade for boilers in November one of the best months of the year.

Quotations.

NEW YORK, Monday, November 24.

New York prices for Northern and Southern irons for the first half of 1903 are as follows:

Northern:

No. 1 X	$23 25 @ $24 75
No. 2 X	22 00 @ 22 75
No. 2 plain	21 00 @ 21 75

Southern:

No. 1 Foundry	23 25 @ 23 50
No. 2 Foundry	22 25 @ 22 50
No. 3 Foundry	21 50 @ 22 00
No. 4 Foundry	20 50 @ 21 50

Bar Iron—Base sizes—Refined brands, mill price on dock, 1.93c. upward in carload lots. Smaller quantities from store, 2.15 @ 2.20c.

Tool Steel—Base sizes—Good standard quality, 7c.; extra grades, 10c. and upward.

Machinery Steel—Base sizes—From store, 2.10 @ 2.25c.

Cold Rolled Steel Shafting—2.90c. from store for base sizes.

Copper—Lake Superior ingot, 11.40 @ 11.60c.; electrolytic and casting, 11.25 @ 11.40c.

Pig Tin—In 5- and 10-ton lots, f. o. b. New York, 24¾ @ 25c.

Pig Lead—4.10 @ 4.12½c., in 50-ton lots.

Spelter—5 @ 5.20c.

Antimony—Cookson's, 9 @ 9½c.; Hallett's and U. S., 7¼ @ 7½c.

Lard Oil—Prime City, 88 @ 90c., according to brand and quantity, ranging from one barrel up to large lots.

Manufacturers.

Fred McCulley will build a steam shingle mill at Newport, Me.

The plant of the Colorado Paving Company, of Denver, has been burned.

The Joan Lang Paper Company, Philadelphia, Pa., will build a new mill.

J. S. McKee, Muscatine, Ia., will enlarge his Peerless pearl button factory.

The Coanicut Mills, Fall River, Mass., are about to build a new weave shed.

A mill building of the Ashuelot (N. H.) Woolen Company has been burned.

Hoffman & Shelton's underwear factory at Williamstown, Pa., has been burned.

The Sandusky (O.) Automobile & Manufacturing Company is building a factory.

Hohnsebehn & Son, creamery supplies, Waverly, Ia., will build a butter tub factory.

The Dunbar (textile) Mills Company, North Adams, Mass., is adding to its capacity.

The Trojan Button Fastener Company, Troy, N. Y., is about to build a new factory.

The Oxford Manufacturing Company, Ltd., woolens, Oxford, N. S., will enlarge its plant.

The planing and molding mill of A. Schrafft & Co. (Inc.), Newark, N. J., has been burned.

The Utah Ice & Storage Company, Salt Lake City, has had plans drawn for a plant.

The foundation stakes for the plant of the Decatur (Ill.) Bridge Company have been set.

The Michigan Vapor Stove Company, Grand Rapids, is about to erect some buildings.

The Crookston (Minn.) Lumber Company is preparing to erect a big mill at Bemidji Lake.

The Victor Safe & Lock Company, Cincinnati, O., will erect a large addition to its plant.

The brick manufactory of the E. A. Chatfield Company, New Haven, Conn., has been burned.

The plant, at St. Joseph, Mo., of the American Hominy Company, Chicago, Ill., has been burned.

John A. Zunner, New Haven, Conn., is promoting a new brewery and has purchased land for a site.

The Union Match Company, Chicago, is thinking of establishing a factory in Oshkosh, Wis.

The Klots Throwing Company has broken ground for a 230x80-foot silk mill at Cumberland, Md.

A new factory building is being started at the Lynn (Mass.) works of the General Electric Company.

The La Crosse (Wis.) Threshing Machine Company is purchasing 20 acres on which to build a factory.

The Buffalo (N. Y.) Meter Company, manufacturer of water, gas and oil meters, etc., is building a plant.

The Model flour mill of the Liberty Mills, Nashville, Tenn., and an elevator adjoining have been burned.

Steps are being taken toward rebuilding the burned shops of the State university at Fayetteville, Ark.

The Schooley-McClure Company, West Newton, Pa., manufacturer of torpedoes, will move to McKeesport.

It is understood that the Windsor Knitting Mills, of Hagerstown, Md., propose to establish a branch factory.

The factory of J. W. Kilgour & Bro., Beauharnois, Que., manufacturers of furniture, etc., has been burned.

The Niagara Radiator Company will build a large boiler factory adjoining its plant at North Tonawanda, N. Y.

Mattnew J. Whittall is to build a $30,000 weave shed as an addition to his carpet mill in South Worcester, Mass.

Coshocton (O.) capitalists, headed by T. H. Wheeler, are behind a project to build an ice and cold storage plant.

The Roessing Bronze Company, of Allegheny, Pa., has commenced the foundations for a factory at West Etna.

The Hull Manufacturing Company, of Gasport, N. Y., is building a shop to manufacture the Friend spray pumps.

The general contract has been let for an addition to the paint works of the Billings-Chapin Company, Cleveland, O.

The contract has been let to lay foundations for large buildings at Martin's Creek, Pa., for the Superior Cement Company.

The Downingtown (Pa.) Manufacturing Company, Ltd., manufacturer of paper mill machinery, is enlarging its plant.

The shoe manufacturing firm of Wagener Brothers, Penn Yan, N. Y., will erect a factory with 14,000 feet of floor space.

Ex-Congressman S. M. Stephenson, of Menominee, Mich., is prominent in a movement to build a $500,000 beet sugar plant there.

Fire has destroyed a sawmill at one of the plants of the American Car & Foundry Company, of St. Louis, Mo., and elsewhere.

An addition is being built at the rear of a factory in Gardner, Mass., to give Hobby Bros. more room for their machine shop.

A permit has been issued to erect a factory building, 83½x136 feet, for Bridgeman Bros. Company, plumbers' supplies, Philadelphia.

The American Glass Works (C. F. Leng, proprietor), Redman Mills, Pa., have purchased a site for a new plant at Brushton.

The Schmidt & Henry Manufacturing Com-

pany, mattresses, springs, etc., Des Moines, Ia., will erect three new factory buildings.

An addition is being built to the plant of E. D. Douglass, 441 North Fifth street, Philadelphia, Pa., manufacturer of packing boxes.

The American Can Company, the trust, will erect a new $75,000 building in Davenport, Ia., where one of its plants is situated.

A building permit at Wakefield, Mass., has been granted to Winship, Bolt & Co., manufacturers of knit goods, for a factory addition.

The American Steel & Copper Plate Company, New York City, is about to build a 50x100-foot, three-story factory in Jersey City, N. J.

Plans have been filed for shop building enlargements to cost $7,000, for the De La Vergne Refrigerating Machine Company, New York city.

The Algonquin (textile) Printing Company, Fall River, Mass., has awarded the contract for a large new building. Four boilers will be added.

Fire at Camden, N. J., has burned plants of the Camden Manufacturing Company, whiting manufacturer, and of the Nonpareil Cork Company.

The Samuel Bingham's Son Manufacturing Company, Chicago, Ill., manufacturer of printers' rollers, will erect two eight-story buildings for its business.

Stehli & Company, silk weavers, Lancaster, Pa., have bought land for a new silk mill, which will be 900 feet long and contain nearly 1,000 looms.

A large new factory building is about being erected at the Blake plant, in Cambridge, Mass., of the International Steam Pump Company, New York city.

A four-story and basement, 200x55-foot building, with engine and boiler house, is about to be erected for the Lee Hosiery Company, Philadelphia, Pa.

Charles E. Meade, boot and shoe manufacturer, Rochester, N. Y., has broken ground for a new factory, which will be provided with machinery driven by electricity.

Hardinge Bros., Chicago, Ill., have purchased the entire business of the Cataract Precision Lathe Company, Buffalo, N. Y., and of A. W. Gump & Co., Dayton, O.

The White Mountain Paper Company has leased a brick plant in Plaistow, N. H., and will enlarge it. W. A. Moore, a representative of the company, is in charge.

The Goodale Marble Company proposes to enlarge its industry at Great Barrington, Mass., by building a stone sawmill. W. A. Neracher, of Warren, O., is president.

The Colean Implement Company, ePoria, Ill., has begun building a plant to manufacture engines, threshers, etc. The machine shop building will be 80x200 feet.

The Huntsville (Ala.) Hoop & Heading Company has been organized, with a capital stock of $12,000. Jos. Minchener is president. The company will establish a plant at once.

Waltham, Mass., is to have a new industry, the manufacture of embossed steel tile. The concern is a branch of Reizenstein & Co., which has its principal factory in Belgium.

The Wisconsin Sugar Company, of Milwaukee and Menominee Falls, will, it is intimated, build at least two beet sugar plants next spring, one at Watertown and one at Chippewa.

The Nashville (Tenn.) Hardwood Flooring Company is building a factory. John B. Ransom is president; W. K. Phillips, vice-president, and Arthur B. Ransom, secretary and Treasurer.

The plant of the Cooper Brick Company, Akron, O., has been damaged by fire. The engines and boilers were not much damaged, but some of the brick-making machinery was badly injured.

The Novelty Stove & Manufacturing Company, Savannah, Mo., will enlarge its plant in that town, and is also looking for an Eastern location in which to establish a branch factory.

The Rome (N. Y.) Metal Company has purchased 175 acres of land in East Rome for the accommodation of a plant, and has broken ground. The plant will have its own water system.

The Sligo Iron Company, chartered some time ago, proposes to build a mill at or near Connellsville, Pa., and succeed the firm Phillips, Nimmick & Co., of Pittsburgh. It will make bar iron, etc.

The Bay State Tap & Die Company, of Taunton, Mass., has purchased a site located, we understand, in Mansfield, Mass., and in conjunction with the Taunton Twist Drill Company will build a factory.

Charles E. Clark and Hermon E. Clark, of the Rochester (N. Y.) Woolen Company, have purchased the remainder of the old Norway Plains Manufacturing Company's mill property, which has been standing idle.

The Ashland (Ore.) Manufacturing Company's lumber mills, etc., have been sold to E. T. Staples and C. C. Anderson, who represent a syndicate of Boise City, Idaho, and who will make extensive improvements.

The Saco & Pettee Machine Shops, Upper Newton Falls, Mass., and Biddeford, Me., plan to build a 400x60-foot, five-story shop at the latter place. The work will probably be started as soon as possible in the spring.

William Steele & Sons, Philadelphia, Pa., have been awarded a contract for the erection of a mill building for the American Lace Company. It will be 500x66 feet. A one-story brick power-house will also be included.

The Huber-Hodgman Printing Press Company, Taunton, Mass., expects to get into new shops in the spring. B. C. Huber, president, is retiring from the concern, his interest having been bid for by New York parties.

The Norfolk (Va.) Yarn Mills have been chartered with a capital stock of $100,000, and will start a new mill at Lambert's Point. Barton Myers is president; Robert M. Hughes, vice-president; C. Brooks Johnston, secretary.

At Pittsburgh, Pa., it is stated that Monroe Lemon, formerly assistant secretary of the Independent (Window) Glass Company, and others propose to start a new glass factory with a door and sash department for glazing.

Benjamin F. Zurick, an engineer in the employ of the Pusey & Jones Company, Wilmington, Del., has been making plans for the foundations for the new building for the Delaware Pulp Mills and also plans for the building.

The explosion of a boiler in a scrap puddle furnace at the West works of the American Iron & Steel Manufacturing Company, Lebanon, Pa., has damaged the equipment, besides killing four men instantly and injuring many others.

Miscellaneous Wants.

Advertisements will be inserted under this head at 25 cents a line, each insertion. Copy should be sent to reach us not later than Saturday morning for the ensuing week's issue. Answers addressed to our care will be forwarded.

Grant. Gears. See upper corner, page 54.

Punches & dies. Wal.M.Wks., Waltham, Mass.

Caliper cat. free. E. G. Smith, Columbia, Pa.

Order your new or special machines from the Industrial Mach. Co., Newark, N. J.

Will buy or pay royalty for good patented machine or tool. Box 282, AMER. MACH.

Light and fine mach'y to order; models and elec. work specialty. E. O. Chase, Newark, N. J.

First-class designing, drafting and tracing done to order. Address "Experienced Designer," care AMERICAN MACHINIST.

The Wellman Sole Cutting Machine Co., of Medford, Mass., designs and builds light machinery. Correspondence solicited.

An experienced engineer will perfect, simplify or improve upon articles of manufacture. Address Box 236, AMERICAN MACHINIST.

Wanted—An interest in a hardware, mill supply, machinery or belting business in New York city. Address "Cash," care AM. MACH.

F. J. Stokes Machine Co., 13th and Noble sts., Philadelphia, cut light gears, cams and duplicate small machine parts, in quantities.

Wire pointing machinery, from ½ in. downwards; address of maker wanted. Godrich, Wharf street, Aston, Birmingham, Eng.

We manufacture on contract patented hardware specialties, tools, dies, metal stampings, special machinery, etc. Edmonds-Metzel Mfg. Co., 778 to 784 W. Lake st., Chicago, Ill.

Grinding beats filing; try us, on either hardened or soft work; capacity 7 in. diameter, 48 in. long and under. The Garvin Machine Co., Spring and Varick sts., New York.

Wanted—Light machine work and special machinery to build to order, special tools, die and punches; a well-equipped water-power plant and first-class workmen. The Bantam Mfg. Co., Bantam, Conn.

Wanted—Machinist, with from $1,000 to $2,000, to take an interest in and the superintendency of a concern manufacturing laundry machinery in Chicago. Address C. T. Cummins, 210 Larrabee st., Chicago, Ill.

For Sale—A well equipped foundry and machine works, located in a healthy town of about 15,000 population in Alabama; reason for selling, poor health of managing partner. If interested address "Alabama," care AM. M.

Wanted—A large contract to build medium or light automatic machinery; we have the plant, the experience, the capital; cam cutting a specialty; we make the best adjustable reamers. Ott. Mergenthaler Company, Baltimore, Md.

Liberal commission to machinery salesmen able to handle, as a side line, machines suitable for use by railroads, machine shops, saw and planing mills and by all manufacturers of wood and metal. Address Box 241, AMERICAN MACHINIST.

Purchaser for small manufacturing plant in Madison, Wis.; lot, 100x180 feet; machine shop, 32x68, two story, with line shaft and gasoline power; foundry, 40x54, new modern equipment; good location; for sale cheap Hart-Parr Co., Charles City, Iowa.

Wants.

Situation and Help Advertisements only inserted under this head. Rate 25 cents a line for each insertion. About six words make a line. No advertisements under two lines accepted, and no advertisements abbreviated. The cash and copy should be sent to reach us not later than Saturday morning for the ensuing week's issue. Answers addressed to our care will be forwarded. Applicants may specify names to which their replies are not to be forwarded; but replies will not be returned. If not forwarded they will be destroyed without notice. Original letters of recommendation or other papers of value should not be enclosed to unknown correspondents.

Situations Wanted.

Machine designer, etc., wants position. Address Box 63, AMERICAN MACHINIST.

Mechanical draftsman wishes to change. Address Box 264, AMERICAN MACHINIST.

As foreman, by A1, progressive pattern maker. K. G., care AMERICAN MACHINIST.

Draftsman, graduate, few years' experience, wants position. Box 248, AM. MACH.

Draftsman, graduate, 3 years' experience, wants position. Box 260, AMER. MACHINIST.

Mechanical draftsman (technical graduate) wishes change near New York. Box 259, A. M.

Experienced mechanical draftsman, technical graduate, wants to change. Box 250, AMERICAN MACHINIST.

Mechanical draftsman and designer, technical graduate, desires change position. Box 254, AMERICAN MACHINIST.

Mechanical engineer, general work, desires position as chief draftsman or superintendent. Box 231, AMERICAN MACHINIST.

Situation as foreman machinist; 25 years' practical experience, 12 in charge; best references. Box 246, AMERICAN MACHINIST.

First-class electrical and mechanical engineer and draftsman wants to change position. Box 252, AMERICAN MACHINIST.

Manufacturing engineer; labor-saving methods; special tools, jigs, etc.; correspondence solicited. Eugene Wilson, care AM. MACH.

Mechanical draftsman, experienced on machinery, mill work, furnaces, etc., wishes position near New York. Box 258, AM. MACH.

Salesman, correspondent and advertising writer, open for engagement, or would represent a specialty. W. C. H., 143 St. Nicholas ave., New York.

Mechanical draftsman wants position; 3 years' drafting and 4 years' shop experience; New York or vicinity; age 26. Box 253, AMERICAN MACHINIST.

General foreman, responsible man, age 34, experienced in high-class automatic and interchangeable machinery, wishes to make change. Box 261, AMERICAN MACHINIST.

Mechanical draftsman, age 27, 8 years' experience, Corliss engine, refrigerating machinery and general work, desires change of position. Box 256, AMERICAN MACHINIST.

A first-class mechanical draftsman, technical education, 6 years' drawing-room and 3 years' shop experience, desires to change position. M. G., care AMER. MACHINIST.

A mechanical and electrical draftsman, Swede, graduated in Germany, 1 year's drawing and 3 years' shop experience, desires position. O. O., care AMERICAN MACHINIST.

A practical factory superintendent of long experience, who is thoroughly competent in every detail, is open for engagement as manager or superintendent. Address T. H., care AMERICAN MACHINIST.

Mechanical engineer is open for engagement; technical education; large experience as foreman and superintendent, manufacturing small and medium interchangeable machinery. Box 233, AMERICAN MACHINIST.

Situation wanted by an experienced machine shop and toolroom foreman, being desirous of making a change; am at present foreman of a shop employing 60 men; New York State preferred. Box 267, AMERICAN MACHINIST.

Expert on automatic machinery, light and heavy; first-class designer; inventive ability; 10 years' best experience; graduate; fitted for head draftsman, superintendent or to develop inventions; terms moderate. Box 257, A. M.

Mechanical engineer, 13 years' shop and drawing-room experience, familiar with machine tools, cranes, hydraulic and structural work, wants position as chief draftsman or assistant superintendent. Box 251, AM. M.

Engineer, 24 years' experience in constructing of large cylindrical, upright and locomobile boilers, overheaters, water purification apparatus, boiler working and inspecting, seeks employment. Address H. Keferstein, 480 Park ave., New York City.

Help Wanted.

Machinists—Your inventions developed by G. M. Mayer, M. E., Monadnock, Chicago.

Machinists, to introduce my double jaw caliper system. E. G. Smith, Columbia, Pa.

Wanted—Good tool and diemaker on bicycle work. Address Day Mfg. Co., Lakeview, N. Y.

Machinist and toolmaker; give age, experience, etc. Wilson Laundry Mach'y Co., Columbia, Pa.

Shop agents wanted to handle my test indicator. See my illustrated ad., page 66. H. A. Lowe, Waltham, Mass.

Wanted—First-class machinists, bench hands and men accustomed to running turret lathe. Marvin & Casler, Canastota, N. Y.

Wanted—Two good wood patternmakers, experienced on pumps and hydraulic work. The Goulds Mfg. Co., Seneca Falls, N. Y.

Wanted—Experienced salesman on brass-working machinery; give age, reference and salary expected. Box 266, AMER. MACH.

Wanted—First-class machinists, in city near Philadelphia; steady work and good pay. The Reeves Engine Co., Trenton, N. J.

Wanted—First-class, non-union, all-round machinist; good shop and tools; work every day in the year. Box 190, AMER. MACHINIST.

Wanted—Machinists and draftsmen to send postal for free set tables of lathe gearing and valuable formulas and tests. Box 239, A. M.

Machinists, send 5 cents for blueprint table of U. S. standard steam, gas and water pipe, giving tapping sizes. Address E. E. Meyer, Allegheny, Pa.

Wanted—At once, first-class machinists on jig and fixture work; none others need apply. Call on or address The Taft-Peirce Mfg. Co., Woonsocket, R. I.

Wanted—A first-class patternmaker, accustomed to medium-sized work. Apply, stating age, experience and wages expected. Box 244, AMERICAN MACHINIST.

Wanted—A mechanical draftsman on small machinery, jigs and fixtures; state experience, age and salary expected. Address Box 240, AMERICAN MACHINIST.

Wanted—Draftsman with experience in making line drawings for photographic reproduction; must be neat and rapid. Box 249, AMERICAN MACHINIST.

Wanted—A foreman to manage machine shop (connected with large business) and devoted to building special machinery. Write Box 265, AMERICAN MACHINIST.

Wanted—Positions for experienced men, and men for such positions. Address James Brady (late Brady Mfg. Co.), Room J, 20th Floor, 220 Broadway, New York.

Wanted—Lathe and planer hands for night work on heavy machine tool work; good wages to good men. Apply to The Pond Machine Tool Company, Plainfield, N. J.

Wanted—First-class toolmaker, experienced on globe valves, injectors and plumbers' brass work; state age, experience and wages expected. Box 243, AMERICAN MACHINIST.

Wanted—Draftsman who has had practical experience in the shop, capable of acting as assistant designer for a firm building boring mills, planers, etc. Box 255, AM. MACH.

Wanted—Two good, all-round machinists, accustomed to building automatic machinery. Address, stating age, experience and wages expected, Box 245, AMERICAN MACHINIST.

Wanted—A young man to take care of order book in a jobbing foundry; must be familiar with patterns and core boxes; steady work at good wages. Box 191, AMER. MACHINIST.

Wanted—Two tool draftsmen, experienced on small and fine work; good location; 44 hours a week; steady work; to receive notice, state age, experience and wages. Address Box 242, AMERICAN MACHINIST.

Wanted—At once, a first-class draftsman; one accustomed to a general run of machine work and capable of doing his own thinking and designing; a good position to the right man. Address Box 247, AMER. MACHINIST.

Wanted—Experienced mechanical draftsman; New England; experience on paper-making machinery and mill work requisite; state age, education, experience, with whom, and salary required. Box 263, AMER. MACH.

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New Haven Mfg. Co., New Haven, Conn.
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Whitney Mfg. Co., Hartford, Ct.

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Potter & Johnston Mach. Co., Pawtucket, R. I.
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Thompson, Hugh L., Waterbury, Conn.

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Veeder Mfg. Co., Hartford, Conn.

Counting and Printing Wheels
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Pawling & Harnischfeger, Milwaukee, Wis.
Sellers & Co., Wm., Philadel., Pa.
Whiting Foundry Equipment Co., Harvey, Ill.

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Northern Engr. Works, Detroit, Mich.
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Morse Twist Drill & Mach. Co., New Bedford, Mass.
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Newton Mach. Tool Wks., Philadelphia, Pa.
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Pratt & Whitney Co., Hartford, Conn.

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Bliss Co., E. W., Brooklyn, N. Y.
Delivouk & George, Chicago, Ill.
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Pratt & Whitney Co., Hartford, Conn.

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Prentice Bros. Co., Worcester, Mass.

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Cleveland Pneu. Tool Co., Cleveland, Ohio.
Phila. Pneumatic Tool Co., Philadelphia, Pa.
Q & C Co., Chicago, Ill.
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Le Blond Mach. Tool Co., R. K., Cincinnati, O.
McCabe, J. J., New York.
Marshall & Huschart Mchry. Co., Chicago, Ill.
Niles Tool Works Co., New York.
New Haven Mfg. Co., New Haven, Conn.
Pratt & Whitney Co., Hartford, Conn.
Prentice Bros. Co., Worcester, Mass.
Prentiss Tool & Supply Co., New York.
Sibley & Ware, South Bend, Ind.
Washburn Shops, Worcester, Mass.

Drills, Center
Pratt & Whitney Co., Hartford, Conn.
Slocomb & Co., J. T., Providence, R. I.

Drills, Rail
Bement, Miles & Co., New York.
Niles Tool Works Co., New York.

Drills, Ratchet
Parker Co., Chas. Meriden, Ct.
Pratt & Whitney Co., Hartford, Conn.

Dust Collectors
Allington & Curtis Mfg. Co., Saginaw, Mich.

Dynamos
Akron Elec. Mfg. Co., Akron, O.
C & C Electric Co., New York.
Crocker-Wheeler Electric Co., Ampere, N. J.
Eck Dynamo & Motor Co., Belleville, N. J.
General Elec. Co., New York.
Jantz & Leist Elec. Co., Cincin., O.
Mechanical Appliance Co., Milwaukee, Wis.
Northern Elec. Mfg. Co., Madison, Wis.
Robbins & Myers Co., Springfield, Ohio.
Sprague Elec. Co., New York.
Triumph Elec. Co., Cincinnati, O.
Western Electric Co., Chicago, Ill.
Westinghouse Electric & Mfg. Co., Pittsburgh, Pa.

Electrical Supplies
Akron Elec. Mfg. Co., Akron, O.
General Elec. Co., New York.
Triumph Electric Co., Cincin., O.
Western Electric Co., Chicago, Ill.
Westinghouse Elec. & Mfg. Co., Pittsburgh, Pa.

Elevators
Albro-Clem Elevator Co., Philadelphia, Pa.
Howard Iron Wks., Buffalo, N. Y.
Morse, Williams & Co., Phila., Pa.

Emery Wheels
See Grinding Wheels.

Enclosures, Tool-room
Merritt & Co., Philadelphia, Pa.

Engines, Gas and Gasoline
Columbus Mach. Co., Columbus, O.
Cooper Mach. Co., Saltsburg, Pa.
Elyria Engine Co., Elyria, O.
Foos Gas Eng. Co., Springfield, O.
Mietz, August, New York.
National Engine Co., Rockford, Ill.
New England Gas Engine Co., Boston, Mass.
New Era Iron Wks., Dayton, O.
Olds Motor Wks., Lansing, Mich.
Patterson, Gottfried & Hunter, Ltd., New York.
Regal Gasoline Engine Co., Coldwater, Mich.
Springfield Gas Eng. Co., Springfield, O.
Stover Engine Works, Freeport, Ill.
Struthers-Wells Co., Warren, Pa.

Engines, Steam
Buffalo Forge Co., Buffalo, N. Y.
Chandler & Taylor Co., Indianapolis, Ind.
Frick Co., Waynesboro, Pa.
Rand Drill Co., New York.
Struthers-Wells Co., Warren, Pa.

Exhaust Fans
Buffalo Forge Co., Buffalo, N. Y.

Fans, Electric
General Electric Co., New York.
Northern Elec. Mfg. Co., Madison, Wis.
Sprague Elec. Co., New York.
Western Electric Co., Chicago, Ill.
Westinghouse Elec. & Mfg. Co., Pittsburgh, Pa.

Files and Rasps
Barnett Co., G. & H., Phila., Pa.
Etna Mfg. Co., New York.
Hammacher, Schlemmer & Co., New York.
Nicholson File Co., Provl., R. I.

Filing Machines
Cochrane-Bly Mach. Co., Rochester, N. Y.

Fillers, Oil Can
The Winkley Co., Hartford, Conn.

Fittings, Steam
Crane Co., Chicago, Ill.
Crosby Steam Gage & Valve Co., Boston, Mass.
Jenkins Bros., New York.
Lunkenheimer Co., Cincinnati, O.
Walworth Mfg. Co., Boston, Mass.

Flexible Shafts
Chicago Flexible Shaft Co., Chicago, Ill.

Forges
Buffalo Forge Co., Buffalo, N. Y.

Forgings, Drop
Billings & Spencer Co., Hartford, Conn.
Wyman & Gordon, Worcester, Mass.

Forgings, Hydraulic
Wyman & Gordon, Worcester, Mass.

Forgings, Steel
Wyman & Gordon, Worcester, Mass.

Foundry Furnishings
Obermayer Co., S., Cincinnati, O.
Whiting Foundry Equip. Co., Harvey, Ill.

Furnaces, Coal, Gas and Oil
Am. Gas Furnace Co., N. Y. City.
Buffalo Forge Co., Buffalo, N. Y.
Chicago Flexible Shaft Co., Chicago, Ill.
Jacobson Mach. Mfg. Co., Warren, Pa.

Furniture, Machine Shop
New Britain Mach. Co., New Britain, Conn.

Gages, Recording
Bristol Co., Waterbury, Conn.

Gages, Standard
Brown & Sharpe Mfg. Co., Providence, R. I.
Rogers, John M., Boat, Gage & Drill Works, Gloucester City, N. J.
Sawyer Tool Mfg. Co., Fitchburg, Mass.
Slocomb & Co., J. T., Prov., R. I.
Starrett Co., L. S., Athol, Mass.

Gages, Steam
Crosby Steam Gage & Valve Co., Boston, Mass.

Gas Furnaces
Am. Gas Furnace Co., N. Y. City.

Gear Cutting Machinery
Bickford Drill & Tool Co., Cin., O.
Brown & Sharpe Mfg. Co., Providence, R. I.
Dwight Slate Mach Co., Hartford, Conn.
Fellows Gear Shaper Co., Springfield, Vt.
Gleason Tool Co., Rochester, N. Y.
Gould & Eberhardt, Newark, N. J.
Harrington & Son Co., Edwin, Philadelphia, Pa.
Newton Mch. Tool Wks., Phil., Pa.
Niles Tool Works Co., New York.
Saunders Mfg. Co., Dayton, O.
Whiton Machine Co., D. E., New London, Conn.

Gears, Cut
Bilgram, Hugo, Philadelphia, Pa.
Boston Gear Wks., Boston, Mass.
Brown & Sharpe Mfg. Co., Providence, R. I.
Cleveland Gear Wks., Cleveland, O.
Fawcus Mach. Co., Pittsburgh, Pa.
Fellows Gear Shaper Co., Springfield, Vt.
Gleason Tool Co., Rochester, N. Y.
Gould & Eberhardt, Newark, N. J.
Grant Gear Works, Boston, Mass.
Harrington, Son & Co., Edwin, Philadelphia, Pa.
Horsburgh & Scott, Cleveland, O.
New Process Raw Hide Co., Syracuse, N. Y.
Nuttall Co., R. D., Pittsburgh, Pa.
Philadelphia Gear Works, Philadelphia, Pa.
Simonds Mfg. Co., Pittsburgh, Pa.

Gears, Molded
Caldwell & Son Co., H. W., Chicago, Ill.
Franklin Mfg. Co., Syracuse, N. Y.
Greenwald Co., I. & E., Cincin., O.
Poole & Son Co., Robt., Baltimore, Md.

Gears, Rawhide
Chicago Raw Hide Co., Chicago, Ill.
Fawcus Mch. Co., Pittsburgh, Pa.
New Process Raw Hide Co., Syracuse, N. Y.
Nuttall Co., R. D., Pittsburgh, Pa.

Gears, Worm
Albro-Clem Elevator Co., Philadelphia, Pa.
Fawcus Mach. Co., Pittsburgh, Pa.
Morse, Williams & Co., Phila., Pa.
Nuttall Co., R. D., Pittsburgh, Pa.
Simonds Mfg. Co., Pittsburgh, Pa.

Graphite
Dixon Crucible Co., Jos., Jersey City, N. J.
Lubriphite Co., Jersey City, N. J.
Obermayer Co., S., Cincinnati, O.

Grinders, Center
Heald & Son, L. S., Barre, Mass.

Grinders, Cock
Windsor Mach. Co., Windsor, Vt.

Grinders, Cutter
Adams Co., Dubuque, Iowa.
Automatic Mach. Co., Greenfield, Mass.
Brown & Sharpe Mfg. Co., Providence, R. I.
Cincinnati Milling Mach. Co., Cincinnati, O.
Garvin Machine Co., New York.
Norton Emery Wheel Co., Worcester, Mass.
Oesterlein Mach. Co., Cincin., O.
Pratt & Whitney Co., Hartford, Conn.
Rivett-Dock Co., Boston, Mass.

Grinders, Disc
Besly & Co., Chas. H., Chicago, Ill.
Gorton Mach. Co., Geo., Racine, Wis.
Iroquois Mach. Co., Provi., R. I.
Ransom Mfg. Co., Oshkosh, Wis.

Grinders, Drill
Gorton Mach. Co., Geo., Racine, Wis.
Heald & Son, L. S., Barre, Mass.
Standard Tool Co., Cleveland, O.
Washburn Shops, Worcester, Mass.
Wilmarth & Morman Co., Grand Rapids, Mich.

Grinders, Tool
Barnes Co., B. F., Rockford, Ill.
Barnes Co., W. F. & John, Rockford, Ill.
Brown & Sharpe Mfg. Co., Providence, R. I.
Diamond Mach. Co., Prov., R. I.
Gisholt Mach. Co., Madison, Wis.
Iroquois Mach. Co., Provi., R. I.
Landis Tool Co., Waynesboro, Pa.
Northampton Emery Wheel Co., Leeds, Mass.
Oesterlein Mach. Co., Cincin., O.
Ransom Mfg. Co., Oshkosh, Wis.
Safety Emery Wheel Co., Springfield, O.
Whitney Mfg. Co., Hartford, Ct.

Grinding Machines
Besly & Co., Chas. H., Chicago, Ill.
Brown & Sharpe Mfg. Co., Providence, R. I.
Builders' Iron Foundry, Providence, R. I.
Diamond Mach. Co., Prov., R. I.
Falkenau-Sinclair Co., Phila., Pa.
Frasse Co., New York.
Goodell-Pratt Co., Greenfield, Mass.
Gorton Mach. Co., Geo., Racine, Wis.
Greenfield Mach. Co., Greenfield, Mass.
Hill, Clarke & Co., Boston, Mass.
Iroquois Mach. Co., Prov., R. I.
Landis Tool Co., Waynesboro, Pa.
Marshall & Huschart Mchry. Co., Chicago, Ill.
Northampton Emery Wheel Co., Leeds, Mass.
Northern Elec. Mfg. Co., Madison, Wis.
Norton Emery Wheel Co., Worcester, Mass.
Prentiss Tool & Supply Co., New York.
Ransom Mfg. Co., Oshkosh, Wis.
Safety Emery Wheel Co., Springfield, Ohio.
Tanite Co., Stroudsburg, Pa.
Washburn Shops, Worcester, Mass.
Webster & Perks Tool Co., Springfield, O.
Wilmarth & Morman Co., Grand Rapids, Mich.

Grinding Wheels
Abrasive Material Co., Phila., Pa.
Builders' Iron Foundry, Providence, R. I.
Carborundum Co., Niagara Falls, N. Y.
Diamond Mach. Co., Provi., R. I.
Hampden Cor. Wheel Co., Brightwood, Mass.
Northampton Emery Wheel Co., Leeds, Mass.
Norton Emery Wheel Co., Worcester, Mass.
Safety Emery Wheel Co., Springfield, O.
Tanite Co., Stroudsburg, Pa.

Grindstones
Lombard & Co., Boston, Mass.

Gun Barrel Machinery
Bement, Miles & Co., New York.
Diamond Mach. Co., Provi., R. I.
Niles Tool Works Co., New York.
Pond Mach. Tool Co., New York.
Reed Co., F. E., Worcester, Mass.

Hack Saw Blades and Frames
Goodell-Pratt Co., Greenfield, Mass.
Diamond Saw & Stamping Wks., Buffalo, N. Y.
Hammacher, Schlemmer & Co., New York.
Starrett Co., L. S., Athol, Mass.
West Haven Mfg. Co., New Haven, Conn.

Hack Saws, Power
Diamond Saw & Stamping Wks., Buffalo, N. Y.
Frasse Co., New York.
Hoefer Mfg. Co., Freeport, Ill.
Millers Falls Co., New York.
West Haven Mfg. Co., New Haven, Conn.

Hammers, Drop
Bement, Miles & Co., New York.
Billings & Spencer Co., Hartford, Conn.
Bliss Co., E. W., Brooklyn, N. Y.
Iroquois Machine Co., Providence, R. I.
Merrill Bros., Toledo, O.
Mossberg & Granville Mfg. Co., Providence, R. I.
Perkins Mach. Co., Boston, Mass.

Hammers, Pneumatic
Chicago Pneumatic Tool Co., Chicago, Ill.
Cleveland Pneumatic Tool Co., Cleveland, O.
Dallett & Co., Thos. H., Phila., Pa.
Phila. Pneu. Tool Co., Philadelphia, Pa.
Q. & C. Co., Chicago, Ill.
Standard Ry. Equip. Co., St. Louis, Mo.

Hammers, Power
Scranton & Co. The, New Haven, Conn.

Hammers, Steam
Bement, Miles & Co., New York.
Bethlehem Fdry. & Mach. Co., So. Bethlehem, Pa.
Chambersburg Engr. Co., Chambersburg, Pa.
Cleveland Punch & Shear Wks. Co., Cleveland, O.

Heating Machines, Automatic
Am. Gas Furnace Co., New York.

Heating and Ventilating Apparatus
Buffalo Forge Co., Buffalo, N. Y.

Hoisting and Conveying Machinery
Brown Hoisting Mchry. Co., New York.
Caldwell & Son Co., H. W., Chicago, Ill.
Hunt Co., C. W., West New Brighton, N. Y.
Link Belt Engineering Co., Philadelphia, Pa.
Niles-Bement-Pond Co., New York.

Hoists, Electric
C & C Electric Co., New York.
Hunt Co., C. W., West New Brighton, N. Y.
Northern Engineering Works, Detroit, Mich.
Pawling & Harnischfeger, Milwaukee, Wis.
Sprague Electric Co., New York.

Hoists, Hand
Harrington, Son & Co., Edwin, Philadelphia, Pa.
Yale & Towne Mfg. Co., New York.

Hoists, Pneumatic
Chicago Pneumatic Tool Co., Chicago, Ill.
Cleveland Pneumatic Tool Co., Cleveland, O.
Northern Engineering Wks., Detroit, Mich.
Rand Drill Co., New York.

Indicators, Speed
Starrett Co., L. S., Athol, Mass.

Indicators, Steam
Crosby Steam Gage & Valve Co., Boston, Mass.

Injectors
Lunkenheimer Co., Cincinnati, O.
Sellers & Co., Wm., Phila., Pa.

Inspection and Tests
Hunt Co., Robt. W., Chicago, Ill.

Instruction Schools
See Schools, Correspondence.

Insurance, Boiler
Hartford Steam Boiler Insp. & Ins. Co., Hartford, Conn.

Jacks, Hydraulic
Bethlehem Fdry & Mch. Co., So. Bethlehem, Pa.
Watson-Stillman Co., New York.

Key Seaters
Baker Bros., Toledo, O.
Bement, Miles & Co., New York.
Chattanooga Mchry. Co., Chattanooga, Tenn.
Davis Mach. Co., W. P., Rochester, N. Y.
Mitts & Merrill, Saginaw, Mich.
Nazel Mach. Works, Phila., Pa.

Keys, Machine
Standard Gauge Steel Co., Beaver Falls, Pa.
Whitney Mfg. Co., Hartford, Ct.

Lamps, Arc
General Electric Co., N. Y. City.
Western Electric Co., Chicago, Ill.
Westinghouse Elec. & Mfg. Co., Pittsburgh, Pa.

Lathes
American Tool Wks. Co., Cin., O.
Auto. Mach. Co., Bridgeport, Ct.
Automatic Mach. Co., Greenfield, Mass.
Barnes Co., B. F., Rockford, Ill.
Barnes Co., W. F. & John, Rockford, Ill.
Bement, Miles & Co., New York.
Bradford Mach. Tool Co., Cin., O.
Bullard Mach. Tool Co., Bridgeport, Conn.
Davis Mach. Co., W. P., Rochester, N. Y.
Diamond Machine Co., Provi., R. I.
Fay & Scott, Dexter, Me.
Flather & Co., Nashua, N. H.
Frasse Co., New York.
Garvin Mach. Co., New York.
Harrington, Son & Co., Edwin, Philadelphia, Pa.
Hendey Mach. Co., Torrington, Ct.
Hill, Clarke & Co., Boston, Mass.
Le Blond Mach. Tool Co., R. K., Cincinnati, O.
Lodge & Shipley Mch. Tool Co., Cincinnati, O.
McCabe, J. J., Nw York.
Marshall & Huschart Mchry. Co., Chicago, Ill.
New Haven Mfg. Co., New Haven, Conn.
Niles Tool Works Co., New York.
Pond Mach. Tool Co., New York.
Pratt & Whitney Co., Hartford, Conn.
Prentice Bros. Co., Worcester, Mass.
Prentiss Tool & Supply Co., New York.
Reed Co., F. E., Worcester, Mass.
Schumacher & Boye, Cincinnati, Ohio.
Sebastian Lathe Co., Cincin., O.
Seneca Falls Mfg. Co., Seneca Falls, N. Y.
Tanite Co., Stroudsburg, Pa.
Washburn Shops, Worcester, Mass.

Lathe Dogs
Armstrong Bros. Tool Co., Chicago, Ill.
Besly & Co., Chas. H., Chicago, Ill.
Le Count, Wm. G., So. Norwalk, Conn.
Pratt & Whitney Co., Hartford, Conn.

Lathes, Automatic Screw-Threading
Automatic Machine Co., Bridgeport, Conn.

Lathes, Bench
Faneuil Watch Tool Co., Boston, Mass.
Waltham Watch Tool Co., Springfield, Mass.

Lathes, Wood
American Machinery Co., Grand Rapids, Mich.

Letters, Pattern
Butler, A. G., N. Y. City.

Levels
Starrett Co., L. S., Athol, Mass.

Lockers, Clothes
Merritt & Co., Philadelphia, Pa.
Narragansett Mach. Co., Providence, R. I.

Locomotives, Shop
Hunt Co., C. W., West New Brighton, N. Y.

Lubricants
Besly & Co., Chas. H., Chicago, Ill.
Dixon Crucible Co., Jos., Jersey City, N. J.
Lubriphite Co., Jersey City, N. J.

Lubricators
Besly & Co., Chas. H., Chicago, Ill.
Bowen Mfg. Co., Auburn, N. Y.
Crane Co., Chicago, Ill.
Lubriphite Co., Jersey City, N. J.
Lunkenheimer Co., Cincinnati, O.

Machine Screws
Atlantic Mach. Screw Co., Boston, Mass.
Worcester Mach. Screw Co., Worcester, Mass.

Machinery Builders, Special
American Fdry. & Mach. Co., Hanover, Pa.
Atlas Foundry & Mach. Co., Belleville, N. J.
Blanchard Mach. Co., The, Boston, Mass.
Fawcus Mch. Co., Pittsburgh, Pa.
Nazel Mach. Works, Phila., Pa.
Pratt & Whitney Co., Hartford, Conn.
Simonds Mfg. Co., Pittsburgh, Pa.

Machinists' Small Tools
Besly & Co., Chas. H., Chicago, Ill.
Billings & Spencer Co., Hartford, Conn.
Brown & Sharpe Mfg. Co., Providence, R. I.
Cleveland Twist Drill Co., Cleveland, O.
Hammacher, Schlemmer & Co., New York.
Lowe, H. A., Waltham, Mass.
McCrosky & Huber, Cincinnati, O.
Patterson, Gottfried & Hunter, Ltd., New York.
Sawyer Tool Mfg. Co., Fitchburg, Mass.
Slocomb & Co., J. T., Provi., R. I.
Starrett Co., L. S., Athol, Mass.
Wyke & Co., J., E. Boston, Mass.

Mandrels, Expanding
Nicholson & Son, W. H., Wilkesbarre, Pa.

Mandrels, Solid
Cleveland Twist Drill Co., Cleveland, O.
Morse Twist Drill & Mach. Co., New Bedford, Mass.
Rogers, John M., Boat, Gage & Drill Works, Gloucester City, N. J.
Standard Tool Co., Cleveland, O.

Measuring Machines
Rogers, John M., Boat, Gage & Drill Works, Gloucester City, N. J.

Micrometer Calipers
Brown & Sharpe Mfg. Co., Providence, R. I.
Sawyer Tool Mfg. Co., Fitchburg, Mass.
Slocomb & Co., J. T., Providence, R. I.
Starrett Co., L. S., Athol, Mass.

Milling Attachments
The Adams Co., Dubuque, Iowa.
Brown & Sharpe Mfg. Co., Providence, R. I.
Cincinnati Milling Mach. Co., Cincinnati, O.
Kempsmith Mfg. Co., Milwaukee, Wis.
Oesterlein Mach. Co., Cincin., O.

Milling Machines, Bench
Faneuil Watch Tool Co., Boston, Mass.
Hill, Clarke & Co., Boston, Mass.
Waltham Watch Tool Co., Springfield, Mass.

Milling Machines, Plain
American Tool Wks. Co., Cin., O.
Bement, Miles & Co., New York.
Brown & Sharpe Mfg. Co., Providence, R. I.
Cincinnati Milling Mach. Co., Cincinnati, O.
Garvin Mach. Co., New York.
Hendey Mach. Co., Torrington, Ct.
Hill, Clarke & Co., Boston, Mass.
Kempsmith Mfg. Co., Milwaukee, Wis.
Le Blond Mach. Tool Co., R. K., Cincinnati, O.
Marshall & Huschart Mchry Co., Chicago, Ill.
McCabe, J. J., New York.
Oesterlein Mach. Co., Cincin., O.
Owen Mach. Tool Co., Springfield, Ohio.
Prentiss Tool & Supply Co., New York.
Whitney Mfg. Co., Hartford, Ct.

Milling Machines, Portable
Underwood & Co., H. B., Philadelphia, Pa.

Milling Machines, Horizontal
Adams Co., Dubuque, Iowa.
Beaman & Smith Co., Prov., R. I.
Bement, Miles & Co., New York.
Franklin Mach. Wks., Phila., Pa.
Hendey Mach. Co., Torrington, Ct.
Ingersoll Mill. Mach. Co., Rockford, Ill.
Newton Mach. Tool Wks., Philadelphia, Pa.
Niles Tool Works Co., New York.
Pratt & Whitney Co., Hartford, Conn.

Milling Machines, Vertical
Bement, Miles & Co., New York.
Brown & Sharpe Mfg. Co., Providence, R. I.
Garvin Mach. Co., New York.
Ingersoll Mill. Mach. Co., Rockford, Ill.
Newton Mch. Tool Works, Philadelphia, Pa.
Niles Tool Works Co., New York.
Owen Mach. Tool Co., Springfield, Ohio.
Pratt & Whitney Co., Hartford, Conn.

Milling Machines, Universal
American Tool Wks. Co., Cin., O.
Bement, Miles & Co., New York.
Brown & Sharpe Mfg. Co., Providence, R. I.
Cincinnati Milling Mach. Co., Cincinnati, O.
Garvin Mach. Co., New York.
Hendey Mach. Co., Torrington, Ct.
Hill, Clarke & Co., Boston, Mass.
Kempsmith Mfg. Co., Milwaukee, Wis.
Le Blond Mach. Tool Co., R. K., Cincinnati, O.
Marshall & Huschart Mchry. Co., Chicago, Ill.
McCabe, J. J., New York.
Niles Tool Works Co., New York.
Oesterlein Mach. Co., Cincin., O.
Owen Mach. Tool Co., Springfield, Ohio.
Prentiss Tool & Supply Co., New York.
Waltham Watch Tool Co., Springfield, Mass.

Milling Tools, Adjustable
Geometric Drill Co., New Haven, Conn.
Rogers, Boat, Gage & Drill Wks., John M., Gloucester City, N. J.

Molding Machines
The Adams Co., Dubuque, Iowa.
American Foundry & Mach. Co., Hanover, Pa.
Tabor Mfg. Co., Philadelphia, Pa.
Webster & Perks Tool Co., Springfield, O.

Molds, Hammer and Vise Jaw
Field, Chas. H., Providence, R. I.

Motors, Electric
Akron Elec. Mfg. Co., Akron, O.
C & C Electric Co., New York.
Christensen Engr. Co., Milwaukee, Wis.
Crocker-Wheeler Co., Ampere, N. J.
Eck Dynamo & Motor Wks., Belleville, N. J.
General Electric Co., New York.
Jantz & Leist Elec. Co., Cin., O.
Mechanical Appliance Co., Milwaukee, Wis.
Northern Elec. Mfg. Co., Madison, Wis.
Robbins & Myers Co., Springfield, Ohio.
Sprague Electric Co., New York.
Triumph Elec. Co., Cincinnati, O.
Western Electric Co., Chicago, Ill.
Westinghouse Elec. & Mfg. Co., Pittsburgh, Pa.

Nail Machinery, Wire
National Machy. Co., Tiffin, O.

Name Plates
Franklin Mfg. Co., Syracuse, N. Y.

Nut Tappers
See Bolt and Nut Machinery.

Oils
Besly & Co., Chas. H., Chicago, Ill.
Houghton & Co., E. F., Philadelphia, Pa.

Oil Cups and Covers
Bay State Stamping Works, Worcester, Mass.
Besly & Co., Chas. H., Chicago, Ill.
Bowen Mfg. Co., Auburn, N. Y.
Crane Co., Chicago, Ill.
Lunkenheimer Co., Cincinnati, O.
The Winkley Co., Hartford, Conn.

Packing, Steam Joint
Jenkins Bros., New York.

Pans, Lathe
New Britain Mch. Co., New Britain, Conn.

Pans, Shop
Kilbourne & Jacobs Mfg. Co., Columbus, O.

Patents
Baldwin, Davidson & Wight, Washington, D. C.

Pattern Shop Machinery
American Machinery Co., Grand Rapids, Mich.
Baker Bros., Toledo, O.
Fay & Scott, Dexter, Me.
Prentiss Tool & Supply Co., New York.
Washburn Shops, Worcester, Mass.

Patterns, Wood
Gobeille Pattern Co., Cleveland, O.
Hartford Pattern & Model Co., Hartford, Conn.

Pencils
Keuffel & Esser Co., New York.

Pipe and Fittings
Crane Co., Chicago, Ill.

Pipe Cutting and Threading Machines
Curtis & Curtis Co., Bridgeport, Conn.
Merrell Mfg. Co., Toledo, O.
Oster Mfg. Co., Cleveland, O.
Saunders' Sons, D., Yonkers, N. Y.
Wells Bros. Co., Greenfield, Mass.

Pipe Fitters' Tools
Cleveland Twist Drill Co., Cleveland, O.
Saunders' Sons, D., Yonkers, N. Y.
Standard Tool Co., Cleveland, O.

Planer, Jack
Armstrong Bros. Tool Co., Chicago, Ill.

Planers
American Tool Wks. Co., Cin., O.
Belmer Mach. Tool Co., Cin., O.
Bement, Miles & Co., New York.
Betts Mach. Co., Wilmington, Del.
Cincinnati Planer Co., Cincin., O.
Detrick & Harvey Mch. Co., Baltimore, Md.
Flather Planer Co., Mark, Nashua, N. H.
Garvin Mach. Co., New York.
Gray Co., G. A., Cincinnati, O.
Harrington, Son & Co., Edwin, Philadelphia, Pa.
Hendey Mach. Co., Torrington, Ct.
Hill, Clarke & Co., Boston, Mass.
McCabe, J. J., New York.
Niles Tool Works Co., New York.
New Haven Mfg. Co., New Haven, Conn.
Pond Mach. Tool Co., New York.
Prentiss Tool & Supply Co., New York.
Sellers & Co., Wm., Phila., Pa.
Whitcomb Mfg. Co., Worcester, Mass.
Woodward & Powell Planer Co., Worcester, Mass.

Planers, Bench
Bartlett, E. E., Boston, Mass.

Planers, Rotary
Bement, Miles & Co., New York.
Cleveland Punch & Shear Works, Cleveland, O.
Franklin Mach. Wks., Phila., Pa.
Newton Mach. Tool Wks., Philadelphia, Pa.
Pond Mach. Tool Co., New York.

Presses, Hand
Perkins Mach. Co., So. Boston, Mass.

Presses, Hydraulic
Bement, Miles & Co., New York.
Watson-Stillman Co., New York.

Presses, Power
Automatic Mach. Co., Bridgeport, Conn.
Bethlehem Fdry. & Mch. Co., So. Bethlehem, Pa.
Bliss Co., E. W., Brooklyn, N. Y.
Dellvouk & George, Chicago, Ill.
Dill Mach. Co., T. C., Phila., Pa.
Mossberg & Granville Mfg. Co., Providence, R. I.
Perkins Mach. Co., Boston, Mass.
Prentiss Tool & Supply Co., New York.
Wold & Co., Torris, Chicago, Ill.

Profilers
Garvin Mach. Co., New York.
Pratt & Whitney Co., Hartford, Conn.

Pulley Turning and Boring Machines
American Tool Wks. Co., Cin., O.
Harrington, Son & Co., Edwin, Philadelphia, Pa.
New Haven Mfg. Co., New Haven, Conn.
Niles Tool Works Co., New York.

Pulleys
Caldwell & Son Co., H. W., Chicago, Ill.
Cresson Co., Geo. V., Phila., Pa.
Howard Iron Wks., Buffalo, N. Y.
Poole & Son Co., Robt., Baltimore, Md.
Reeves Pulley Co., Columbus, Ind.
Saunders Mfg. Co., Dayton, O.

Pulleys, Friction Cone
Evans Friction Cone Co., Boston, Mass.

Pulleys, Speed Changing
Speed Changing Pulley Co., Indianapolis, Ind.

Pumps, Hydraulic
Watson-Stillman Co., New York.

Punches, Hydraulic
Bement, Miles & Co., New York.
Bethlehem Fdry. & Mch. Co., So. Bethlehem, Pa.
Watson-Stillman Co., New York.

Punches, Power
Bliss Co., E. W., Brooklyn, N. Y.
Bremer Mach. & Tool Co., Kalamazoo, Mich.
Buffalo Forge Co., Buffalo, N. Y.
Cincinnati Punch & Shear Co., Cincinnati, O.
Cleveland Punch & Shear Wks., Cleveland, O.
Hilles & Jones Co., Wilmington, Del.
Long & Allstatter Co., Hamilton, Ohio.
Perkins Mach. Co., So. Boston, Mass.
Reade Mchry Co., Cleveland, O.

Rack Cutting Machines
Fellows Gear Shaper Co., Springfield, Vt.
Le Blond Mach. Tool Co., R. K., Cincinnati, O.
Reed Co., F. E., Worcester, Mass.

Racks, Cut
Fellows Gear Shaper Co., Springfield, Vt.
Nuttall Co., R. D., Pittsburgh, Pa.
Simonds Mfg. Co., Pittsburgh, Pa.
Standard Gauge Steel Co., Beaver Falls, Pa.

Racks, Tool
New Britain Mach. Co., New Britain, Conn.

Reamers
Cleveland Twist Drill Co., Cleveland, O.
Clough, R. M., Tolland, Conn.
McCrosky & Huber, Cincinnati, O.
Morse Twist Drill & Mach. Co., New Bedford, Mass.
Pratt & Whitney Co., Hartford, Conn.
Rogers, John M., Boat, Gage & Drill Works, Gloucester City, N. J.
Standard Tool Co., Cleveland, O.
Wells Bros. Co., Greenfield, Mass.

Reaming Stands
Flather Planer Co., Mark, Nashua, N. H.

Riveters, Hydraulic
Bement, Miles & Co., New York.
Watson-Stillman Co., New York.

Riveters, Pneumatic
Bement, Miles & Co., New York.
Cleveland Pneumatic Tool Co., Cleveland, O.
Philadelphia Pneumatic Tool Co., Philadelphia, Pa.
Q & C Co., Chicago, Ill.
Standard Ry. Equip. Co., St. Louis, Mo.

Riveting Machines
Bement, Miles & Co., New York.
Bethlehem Foundry & Mach. Co., So. Bethlehem, Pa.
Chambersburg Engr. Co., Chambersburg, Pa.
Long & Allstatter Co., Hamilton, Ohio.
Perkins Mach. Co., So. Boston, Mass.

Rods and Straps, Connecting
Standard Connecting Rod Co., Beaver Falls, Pa.

Rolling Mill Machinery
Cincinnati Punch & Shear Co., Cincinnati, O.
Cleveland Punch & Shear Wks. Co., Cleveland, O.
Diamond Drill & Mch. Co., Birdsboro, Pa.
Dill Mach. Co., T. C., Phila., Pa.
Hilles & Jones Co., Wilmington, Del.
Iroquois Mach. Co., Providence, R. I.
Mossberg & Granville Mfg. Co., Providence, R. I.
Pratt & Whitney Co., Hartford, Conn.

Roller and Ball Bearings
Ball Bearing Co., Philadel., Pa.
Iroquois Mach. Co., Providence, R. I.
Mossberg & Granville Mfg. Co., Providence, R. I.

Rules, Steel
Sawyer Tool Co., Fitchburg, Mass.
Starrett Co., L. S., Athol, Mass.

Safety Valves, Pop
Crane Co., Chicago, Ill.
Crosby Steam Gage & Valve Co., Boston, Mass.
Lunkenheimer Co., Cincinnati, O.

Sawing Machines, Metal
Cleveland Punch & Shear Works Co., Cleveland, O.
Cochrane-Bly Mach. Works, Rochester, N. Y.
Newton Mach. Tool Works, Philadelphia, Pa.
Pratt & Whitney Co., Hartford, Conn.
Reade Mchry. Co., Cleveland, O.

Sawing Machines, Wood
American Machinery Co., Grand Rapids, Mich.

Schools, Correspondence
Amer. School of Correspondence, Boston, Mass.
Consolidated Schools, N. Y. City.
International Correspond. Schools, Scranton, Pa.

Screw Machines, Automatic
Brown & Sharpe Mfg. Co., Providence, R. I.
Cleveland Automatic Mach. Co., Cleveland, Ohio.
Dreses Mach. Tool Co., Cincin., O.
Marshall & Huschart Mchry. Co., Chicago, Ill.
Windsor Mach. Co., Windsor, Vt.

Screw Machines, Hand
Brown & Sharpe Mfg. Co., Providence, R. I.
Cleveland Automatic Mach. Co., Cleveland, O.
Garvin Mach. Co., New York.
Jones & Lamson Mch. Co., Springfield, Vt.
Pearson Mach. Co., Chicago, Ill.
Potter & Johnston Mach. Co., Pawtucket, R. I.
Pratt & Whitney Co., Hartford, Conn.
Warner & Swasey Co., Cleveland, Ohio.
Windsor Mach. Co., Windsor, Vt.

Screw Machinery, Wood and Lag
Baker Bros., Toledo, Ohio.
Cook Co., Asa S., Hartford, Conn.

Screw Plates
Besly & Co., Chas. H., Chicago, Ill.
Carpenter Tap & Die Co., J. M., Pawtucket, R. I.
Card Mfg. Co., S. W., Mansfield, Mass.
Hart Mfg. Co., Cleveland, O.
Morse Twist Drill & Mach. Co., New Bedford, Mass.
Oster Mfg. Co., Cleveland, O.
Wells Bros. Co., Greenfield, Mass.
Wiley & Russell Mfg. Co., Greenfield, Mass.

Second Hand Machinery
Affleck, Geo. E., New York.
Baird Machy. Co., Pittsburgh, Pa. Pa.
Bowler & Co., Geo. H., Cleveland, Ohio.
Carlin Mchry. & Supply Co., Allegheny, Pa.
Dawson, John H., Chicago, Ill.
Fairbanks Co., Philadelphia, Pa.
Garvin Mch. Co., New York.
Hill, Clarke & Co., Boston, Mass.
Marshall & Huschart Mchry. Co., Chicago, Ill.
McCabe, J. J., New York.

Second Hand Machinery—*Cont'd*
Niles Tool Works Co., New York.
Pratt & Whitney Co., Hartford, Conn.
Prentiss Tool & Supply Co., New York.
Toomey, Frank, Philadelphia, Pa.
Wickes Bros., New York.
Wormer Machy. Co., C. C., Detroit, Mich.

Separators, Oil
American Tool & Mach. Co., Boston, Mass.

Shafts, Crank
Standard Connecting Rod Co., Beaver Falls, Pa.

Shapers
American Tool Wks. Co., Cin. O.
Bement, Miles & Co., New York.
Cincinnati Shaper Co., Cincin., O.
Flather Planer Co., Mark, Nashua, N. H.
Garvin Mach. Co., New York.
Hendey Mch. Co., Torrington, Ct.
Gould & Eberhardt, Newark, N. J.
Hill, Clarke & Co., Boston, Mass.
Kelly Co., R. A., Xenia, Ohio.
Marshall & Huschart Mchry. Co., Chicago, Ill.
New Haven Mfg. Co., New Haven, Conn.
Niles Tool Works Co., New York.
Perkins Mach. Co., Boston, Mass.
Potter & Johnston Mach. Co., Pawtucket, R. I.
Steptoe & Co., John, Cincinnati, O.

Shears, Power
Bethlehem Fdry. & Mch. Co., So. Bethlehem, Pa.
Bliss Co., E. W., Brooklyn, N. Y.
Bremer Mach. & Tool Co., Kalamazoo, Mich.
Buffalo Forge Co., Buffalo, N. Y.
Cleveland Punch & Shear Works, Cleveland, O.
Hilles & Jones Co., Wilmington, Del.
Long & Allstatter Co., Hamilton, Ohio.
National Mchry. Co., Tiffin, O.
Perkins Mach. Co., Boston, Mass.
Reade Mchry Co., Cleveland, O.

Shears, Rotary
Bethlehem Foundry & Mach. Co., So. Bethlehem, Pa.
Detrick & Harvey Mach. Co., Baltimore, Md.
Perkins Mach. Co., So. Boston, Mass.

Shelving, Shop
New Britain Mach. Co., New Britain, Conn.

Slide Rests
Bartlett, E. E., Boston, Mass.
Reed Co., F. E., Worcester, Mass.

Slotters
Baker Bros., Toledo, Ohio.
Bement, Miles & Co., New York.
Betts Mach. Wks., Wilmington, Del.
Dill Mach. Co., T. C., Phila., Pa.
Franklin Mach. Wks., Phila., Pa.
Garvin Mach. Co., New York.
New Haven Mfg. Co., New Haven, Conn.
Newton Mach. Tool Wks., Philadelphia, Pa.
Niles Tool Works Co., New York.

Spike Machines
National Machy. Co., Tiffin, O.

Sprocket Chains
See Driving Chains.

Stampings, Sheet Steel
Federal Mfg. Co., Cleveland, O.

Stamps, Steel
The Chandler Co., Springfield, Mass.
Schwerdtle Stamp Co., Bridgeport, Conn.

Steel, Machinery
Boker & Co., Hermann, New York.
Patriarche & Bell, New York.
Ward & Son, Edgar T., Boston, Mass.

Steel, Sheet
Federal Mfg. Co., Cleveland, O.
Ward & Son, Edgar T., Boston, Mass.

Steel, Tool
Boker & Co., Hermann, New York.
Patriarche & Bell, New York.

Straightener, Hydraulic
Bement, Miles & Co., New York.
Watson-Stillman Co., New York.

Swaging Machines
Excelsior Needle Co., Torrington, Conn.
Iroquois Mach. Co., Provi., R. I.
Mossberg & Granville Mfg. Co., Providence, R. I.

Switchboards
C & C Electric Co., New York.
Electric Controller & Supply Co., Cleveland, O.
Triumph Elec. Co., Cincinnati, O.
Western Electric Co., Chicago, Ill.

Tapping Machines and Attachments
Baker Bros., Toledo, O.
The Beaman & Smith Co., Providence, R. I.
Bickford Drill & Tool Co., Cin., O.
Cincinnati Mach. Tool Co., Cincinnati, O.
Errington, F. A., N. Y. City.
Fosdick Mach. Tool Co., Cin., O.
Garvin Mach. Co., New York.
Geometric Drill Co., New Haven, Conn.
National Mchry. Co., Tiffin, O.
Pratt & Whitney Co., Hartford, Conn.
Seneca Falls Mfg. Co., Seneca Falls, N. Y.
Webster & Perks Tool Co., Springfield, O.

Taps, Collapsing
Geometric Drill Co., New Haven, Conn.

Taps and Dies
Besly & Co., Chas. H., Chicago, Ill.
Card Mfg. Co., S. W., Mansfield, Mass.
Carpenter Tap & Die Co., J. M., Pawtucket, R. I.
Cleveland Twist Drill Co., Cleveland, O.
Crane Co., Chicago, Ill.
Hammacher, Schlemmer & Co., New York.
Hart Mfg. Co., Cleveland, O.
Morse Twist Drill & Mach. Co., New Bedford, Mass.
National Mchry. Co., Tiffin, O.
Oster Mfg. Co., Cleveland, O.
Pratt & Whitney Co., Hartford, Conn.
Standard Tool Co., Cleveland, O.
Webster & Perks Tool Co., Springfield, O.
Wells Bros. Co., Greenfield, Mass.
Wiley & Russell Mfg. Co., Greenfield, Mass.
Winter Bros. Co., Wrentham, Mass.

Telephone System
Clarke Auto. Telephone Switch Board Co., Providence, R. I.

Thread Cutting Tools
Besly & Co., Chas. H., Chicago, Ill.
Hart Mfg. Co., Cleveland, O.
Oster Mfg. Co., Cleveland, O.
Pratt & Whitney Co., Hartford, Conn.
Rivett-Dock Co., Boston, Mass.

Tool Holders
Armstrong Bros. Tool Co., Chicago, Ill.
Hoggson & Pettis Mfg. Co., New Haven, Conn.
McCrosky & Huber, Cincinnati, O.

Tools
See Machinists' Small Tools.

Transmission Machinery
Caldwell & Son Co., H. W., Chicago, Ill.
Cresson & Co., Geo. V., Phila., Pa.
Link-Belt Engineering Co., Philadelphia, Pa.
Patterson, Gottfried & Hunter, Ltd., New York.
Reeves Pulley Co., Columbus, Ind.
Saunders Mfg. Co., Dayton, O.

Traps, Steam
Houghton & Co., E. F., Philadelphia, Pa.

Trimmers, Wood
Amer. Mchry. Co., Grand Rapids, Mich.
Washburn Shops, Worcester, Mass.

Trolleys and Tramways
Brown Hoisting Machy. Co., N. Y. City.
Harrington, Son & Co., Edwin, Philadelphia, Pa.
Hunt Co., C. W., West New Brighton, N. Y.
Link Belt Engineering Co., Philadelphia, Pa.
Maris Bros., Philadelphia, Pa.
Yale & Towne Mfg. Co., New York.

Tube Cutter, Glass
Gifford & Morrow, Tyrone, Pa.

Turrets, Carriage
Fay & Scott, Dexter, Me.

Turret Machines
American Tool & Mach. Co., Boston, Mass.
Automatic Mach. Co., Greenfield, Mass.
Bradford Mach. Tool Co., Cincinnati, O.
Brown & Sharpe Mfg. Co., Providence, R. I.
Bullard Mach. Tool Co., Bridgeport, Conn.
Dreses Mach. Tool Co., Cincin., O.
Flather & Co., Nashua, N. H.
Garvin Mach. Co., New York.
Gisholt Mch. Co., Madison, Wis.
Hill, Clarke & Co., Boston, Mass.
Jones & Lamson Mch. Co., Springfield, Vt.
Le Blond Mach. Tool Co., R. K., Cincinnati, O.
Lodge & Shipley Mach. Tool Co., Cincinnati, O.
Niles Tool Works Co., New York.
Pearson Mach. Co., Chicago, Ill.
Potter & Johnston Mach. Co., Pawtucket, R. I.
Warner & Swasey Co., Cleveland, Ohio.
Windsor Mach. Co., Windsor, Vt.

Twist Drills
Cleveland Twist Drill Co., Cleveland, O.
Etna Mfg. Co., New York.
Hammacher, Schlemmer & Co., New York.
Morse Twist Drill & M. Co., New Bedford, Mass.
Standard Tool Co., Cleveland, O.

Universal Joints
Baush Machine Tool Co., Springfield, Mass.

Valves
See Steam Fittings.

Vises, Drill
Graham Mfg. Co., Provi., R. I.
Jacobson Mach. Mfg. Co., Warren, Pa.

Vises, Metal Workers'
Hammacher, Schlemmer & Co., New York.
Howard Iron Wks., Buffalo, N. Y.
Jacobson Mach. Mfg. Co., Warren, Pa.
Parker Co., Chas., Meriden, Conn.
Walworth Mfg. Co., Boston, Mass.

Vises, Pipe
Curtis & Curtis Co., Bridgeport, Conn.
Saunders' Sons, D., Yonkers, N. Y.
Walworth Mfg. Co., Boston, Mass.

Vises, Planer and Shaper
Cincinnati Planer Co., Cincin., O.
Hendey Mach. Co., Torrington, Ct.
Pratt & Whitney Co., Hartford, Conn.

Vises, Wood Workers'
Hammacher, Schlemmer & Co., New York.
Wyman & Gordon, Worcester, Mass.

Washer Machines
National Machy. Co., Tiffin, O.

Welding Machines
Long & Allstatter Co., Hamilton, Ohio.

Wire-Drawing Machinery
Iroquois Mach. Co., Provi., R. I.
Mossberg & Granville Mfg. Co., Providence, R. I.

Wire-Forming Machinery
Automatic Mach. Co., Bridgeport, Conn.

Wood Working Machinery
American Machinery Co., Grand Rapids, Mich.

Worm Hobbing Machines
Pratt & Whitney Co., Hartford, Conn.

Worm Milling Machines
Cleveland Automatic Mach. Co., Cleveland, O.
Pratt & Whitney Co., Hartford, Conn.

Wrenches
Coes Wrench Co., Worcester, Mass.

Wrenches, Drop Forged
Billings & Spencer Co., Hartford, Conn.